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CHAPTER 1

Introduction

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Unisphere for VMAX Online Help

Unisphere for VMAX is a web-based application that allows you to configure and manage VMAX storage systems. You can use Unisphere for VMAX to:

- Manage user accounts and roles
- Perform configuration operations (create thin volumes, mask volumes, set storage attributes, set volume attributes, and set port flags)
- Manage volumes (change volume configuration, set volume status, and create/dissolve meta volumes)
- Perform and monitor replication and backup operations:
  - TimeFinder® SnapVX
  - TimeFinder/Snap
  - TimeFinder VP Snap
  - TimeFinder/Clone
  - TimeFinder/Mirror
  - Symmetrix Remote Data Facility (SRDF®)
  - Open Replicator for Symmetrix (ORS)
  - ProtectPointTM
- Manage advanced storage features, such as:
  - Fully Automated Storage Tiering (FAST)TM
  - Fully Automated Storage Tiering for virtual pools (FAST VP)
  - Service level provisioning
  - Workload planning
  - FAST Array Advisor
  - Enhanced Virtual LUN Technology
  - Auto-provisioning Groups
  - Virtual Provisioning
  - Non-disruptive migration (NDM)
  - Federated Live Migration (FLM)
  - Federated Tiered Storage (FTS)
  - Embedded NAS (eNAS)
  - FAST.X
- Monitor alerts, including the ability to configure external alert notifications
- Monitor storage system performance data:
  - Monitor performance and capacity over time
  - Drill-down through data to investigate issues
  - View graphs detailing system performance
  - Set performance thresholds and alerts
  - View high frequency metrics in real time
- Perform root cause analysis
- View storage system heatmaps
- Execute scheduled and ongoing reports (queries), and export that data to a file
- Use predefined dashboards for many of the system components
- Customize your own dashboard templates
- Execute scheduled export of performance dashboards
- Monitor and troubleshoot database performance issues using Database Storage Analyzer

**Using the help system**

For optimum reading experience, the Unisphere for VMAX online help is best viewed in the latest available browsers (IE, Chrome, FireFox).

Finding information:
- Using the Contents tab—Click the book icon to expand the table of contents and display help topics.
- Using the Search tab—Click the Search tab in the navigation pane. Type a search word or phrase and a list of topics that contain the word or phrase displays in the navigation panel. Click on the name of the topic to display it in the View panel.

Your comments—Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Send your opinions to: VMAXContentFeedback.

**Supporting documentation**

For steps to complete the Unisphere for VMAX installation, refer to the Unisphere for VMAX Installation Guide on online support.

For information specific to this Unisphere for VMAX product release, refer to the Unisphere for VMAX Release Notes on online support.

**Capacity information**

Storage capacity can be measured using two different systems – base 2 (binary) and base 10 (decimal). Organizations such as the International System of Units (SI) recommend using the base 10 measurement to describe storage capacity. In base 10 notation, one megabyte (MB) is equal to 1 million bytes, and one gigabyte (GB) is equal to 1 billion bytes.

Operating systems generally measure storage capacity using the base 2 measurement system. Unisphere for VMAX and Solutions Enabler use the base 2 measurement system to display storage capacity along with the TB notation as it is more universally understood. In base 2 notation, one megabyte (MB) is equal to 1,048,576 bytes and one gigabyte (GB) is equal to 1,073,741,824 bytes.

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<th>Decimal Value (in Decimal)</th>
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<td>GB</td>
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<td>1,073,741,824</td>
<td>10&lt;sup&gt;9&lt;/sup&gt;</td>
</tr>
<tr>
<td>terabyte</td>
<td>TB</td>
<td>2&lt;sup&gt;40&lt;/sup&gt;</td>
<td>1,099,511,627,776</td>
<td>10&lt;sup&gt;12&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Introduction
# CHAPTER 2

**Getting Started**

- Operating as the initial setup user ................................................................. 28
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Operating as the initial setup user

When Unisphere for VMAX is first installed, there is a single user called the Initial Setup User (ISU). This user can perform administrative tasks only on storage systems that do not have defined roles (authorization rules). Once an Administrator or SecurityAdmin is assigned to a storage system, the ISU will no longer be able to access or even see the system from the Unisphere console. Therefore, it is recommended that users not operate in this role for too long.

The main tasks of an ISU are:
- Creating local users on page 75
- Adding authorization rules on page 73

Logging in to Unisphere for VMAX

Logging in to Unisphere for VMAX

The Login dialog box contains the following elements:

Username—user name (refer to Login authentication on page 68).

Password—password.

Use SSC on SP—Specifies that you want to log in to using the current secure credentials. After selecting this option, click Login or press Enter. Note that selecting this option disables the remaining fields on this dialog box. This field is for Customer Service personnel and only appears when logging in to on the service processor.

To log in using another Username and Password, you must clear this option.

Login message—this dialog box may also include a login message. The login message feature enables Administrators and StorageAdmins to display a message to users during login. For example, an administrator may want to notify logging in users about a software upgrade.

Login—Opens the console.

Touring the interface

The Unisphere for VMAX interface consists primarily of dashboards and views. Dashboards provide a high-level view of your storage environment, and views provide a low-level view of the various storage objects, for example, groups and volumes. While dashboards provide some management functionality, most of your management tasks begin in the views.

The following example shows a typical view. In this case, the Volumes list view for a storage group.
Getting Started

Title bar

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Clicking on this displays a drop down menu. The menu options available are: Help, About, Export, Settings and Logout. The drop down menu also displays information about the user who is logged onto Unisphere for VMAX.</td>
</tr>
<tr>
<td>Search</td>
<td>Opens the search dialog.</td>
</tr>
</tbody>
</table>

Menu bar

**Note**

Depending on your storage operating environment, some of the following options may not apply.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
</table>
| Home | The Home menu provides access to the following operations:  
- View the Home Dashboard, from which you can view how the well the storage systems are performing, including capacity usage, response time, service level compliance, and alerts.  
- View and manage Administration settings, including:  
  - Alert policies, thresholds, and notifications  
  - Authentication options (local directory, Windows OS/AD, LDAP-SSL)  
  - System preferences  
  - User authorizations  
  - Link and launch client registrations  
- View, acknowledge, and delete alerts for all visible storage systems  
- View/Export storage system capacity information |

System selector

The system selector displays a list of all managed storage systems. It allows you to toggle the interface between two...
modes, All Symmetrix and individual systems. Selections you make in the list provide the context for subsequent operations. For more information, refer to Using the system selector on page 38.

### Storage

The **Storage** menu provides access to the following operations, depending on the storage environment:

- View and manage storage groups (Enginuity version 5876)
- Provision storage to hosts
- View and manage service levels (HYPERMAX OS 5977 or higher)
- View and manage Storage Resource Pools (HYPERMAX OS 5977 or higher)
- View and manage volumes
- View and manage external storage (Enginuity 5876, HYPERMAX OS 5977 or higher)
- View and manage the FAST™ controller policies (Enginuity 5876)
- View and manage thin pools (Enginuity 5773 or 5876)
- View and manage storage tiers (Enginuity 5876)
- View and manage storage volumes
- View and manage storage templates (Enginuity version 5876)
- View and manage disk groups
- View and manage Symmetrix Optimizer (Enginuity version 5773 or 5876)

The **Storage** menu is only available when you select an individual storage system from the system selector.

### Hosts

The **Hosts** menu provides access to the following operations:

- View and manage hosts
- View and manage masking views
- View and manage initiators (rename alias, set attributes, set flags, replace initiator)
- View and manage port groups
- View the Mainframe Dashboard - on Mainframe systems this can be used to monitor and manage configured splits, CU images, and CKD volumes
- View XtremSW Cache adapters
- View and manage virtual servers

The **Hosts** menu is only available when you select an individual storage system from the system selector.
<table>
<thead>
<tr>
<th>Data Protection</th>
<th>The <strong>Data Protection</strong> menu provides access to the following operations:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- View and manage TimeFinder sessions</td>
</tr>
<tr>
<td></td>
<td>- View and manage SRDF sessions</td>
</tr>
<tr>
<td></td>
<td>- View and manage Symmetrix system migration sessions</td>
</tr>
<tr>
<td></td>
<td>- View and manage replication groups and pools</td>
</tr>
<tr>
<td></td>
<td>- View and manage SAN LUNs, Open Replicator, RecoverPoint™, and Federated Live Migration</td>
</tr>
<tr>
<td></td>
<td>The <strong>Data Protection</strong> menu is only available when you select an individual storage system from the system selector.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance</th>
<th>The <strong>Performance</strong> menu provides access to the following operations:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Monitor and manage Symmetrix system dashboards (charts/graphs, heat maps, predefined for FAST)</td>
</tr>
<tr>
<td></td>
<td>- Perform trend analysis for future capacity planning</td>
</tr>
<tr>
<td></td>
<td>- Analyze Symmetrix system data for diagnostic troubleshooting</td>
</tr>
<tr>
<td></td>
<td>- Create charts for historical, diagnostic, and realtime storage system data</td>
</tr>
<tr>
<td></td>
<td>- Manage policies for data collection and polling</td>
</tr>
<tr>
<td></td>
<td>- Customize the performance metrics to your requirements</td>
</tr>
<tr>
<td></td>
<td>- Set thresholds and alert notifications for Symmetrix system components</td>
</tr>
<tr>
<td></td>
<td>- Maintain and schedule captures of a specified time period of real-time data</td>
</tr>
<tr>
<td></td>
<td>- Create, schedule, execute, and export data queries</td>
</tr>
<tr>
<td></td>
<td>- Configure the performance database and perform backups and restores</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Databases</th>
<th>The <strong>Database</strong> menu provides access to the following operations:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- View storage system-visible databases</td>
</tr>
<tr>
<td></td>
<td>- Launch Database Storage Analyzer for optimizing database performance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System</th>
<th>The <strong>System</strong> menu provides access to the following operations:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- View system dashboards, from which you can replace failed spare drives, and perform Symmetrix health checks</td>
</tr>
<tr>
<td></td>
<td>- View and filter records from the system audit log</td>
</tr>
<tr>
<td></td>
<td>- View, acknowledge, and delete alerts for the specified Symmetrix system</td>
</tr>
</tbody>
</table>
### Help
Displays content-sensitive help for current view or dashboard.

### Contents
The main section of the interface is where you perform the majority of your work. This can contain a dashboard; a list view, as shown above; a details view; or a properties view. In either case, this section usually contains a series of controls (buttons) that allow you to act on the displayed content. For example, a volume list may contain **Create** and **Delete** buttons. For operations that you can perform on multiple objects at a time (for example, deleting storage groups), **Shift** and **Ctrl** keys are supported to allow you to select multiple sequential, and non-sequential objects, respectively.

### Status bar
Provides the following information:

- Link to the **Alerts New** list view for the storage system on which you are currently working. The maximum number of alerts Unisphere for VMAX displays is 10,000 per server. Once this threshold is reached, Unisphere for VMAX deletes the oldest alert for each subsequent alert it receives.
- Link to the **Jobs List** for the selected storage system. This only appears after you have selected a storage system.
- The date and time the current contents (view, dashboard, and so on) was last updated.
- ![Refresh](refresh.png) when clicked refreshes data in Unisphere for VMAX console window. Unisphere for VMAX refreshes all its data from the database.
- ![Refresh](refresh.png) when clicked refreshes storage system data. Unisphere for VMAX refreshes storage system data from the database. This operation does not discover new storage systems, only refreshes data from existing systems.

### Using the Home Dashboard
The contents of the Home Dashboard depend on the installation of Unisphere for VMAX you are using.

For more information about the Home Dashboard on embedded Unisphere for VMAX installations, refer to Using the Home Dashboard on embedded installations on page 35.

The **Home Dashboard** provides a single place from which you can quickly determine how your storage systems are performing. The **Home Dashboard** opens by default
when you first open the console. To return to it from another view, click the "Home" icon in the menu bar.

The **Home Dashboard** displays the following, depending on your storage operating environment:

**Note**

Storage systems appear grayed-out when they are in a disabled state. This usually occurs when the server managing the storage system is in the process of starting up.

- **System nice name**, or if not defined, **system ID number**. Unlicensed systems are indicated with a lock icon. To license the system, click the icon to open the **Entitlements** page where you can license the storage system.
- **Model** number
- **Connection** (Local or Remote)
- **Enginuity/HYPERMAX OS** version. Enginuity/HYPERMAX OS versions below the minimum suggested target version display a warning icon. In this case, you should contact your service provider to schedule an upgrade.
- Alert summary icon that displays the alert status and count. Alert status is indicated by icon color:
  - One or more fatal alerts
  - One or more critical alerts, with none higher
  - One or more warning alerts, with none higher
  - No alerts
To view details on the system's alerts, click the alert count (#) to open the system's alert list view.

- **Capacity** — Graphic representation of the system's subscribed and usable capacity (used = blue and free = grey). For storage systems running HYPERMAX OS 5977 or higher, only virtual capacity is displayed. For systems running lower
OS versions, both physical and virtual capacities are displayed. Click the **Capacity** link to open the storage system's dashboard (or the SRP dashboard for systems running HYPERMAX OS 5977 or higher). Data only displays in this field for local storage systems.

- **Overall Efficiency** is also displayed. This is the ratio of the sum of all TDEVs and Snapshot sizes and the Physical Used Storage (calculated based on the compressed pool track size).

- **SG Compliance** — How well the storage system's workload is complying with the overall service level. This field displays for storage systems running HYPERMAX OS 5977 or higher and registered with the Performance component. Data only displays in this field for local storage systems. Possible values are:

  - **Stable** — Number of storage groups performing within the service level targets. ![Stable icon](image)
  - **Marginal** — Number of storage group ps performing below service level targets. ![Marginal icon](image)
  - **Critical** — Number of storage groups performing well below service level targets. ![Critical icon](image)

To view the **Storage Groups Dashboard**, click the **SG Compliance** link. To view the available service levels, click ![Service Levels](image).

- **SG RESPONSE TIME** — Graphic representation of how well the storage system's storage groups are performing. This is determined by analyzing the number of storage groups with more than 10 I/Os per second over the last hour, and then displaying the appropriate icon (green (Stable), yellow (Marginal), red (Critical) disks, as shown earlier for service level compliance). This field displays for storage systems running Enginuity 5874 - 5876 and registered with the Performance component.

- **SYSTEM UTILIZATION** — Graphic representation of the distribution of % busy for the storage system's front-end, back-end, and cache partitions. To calculate the % busy, the system runs through the following categories and metrics over four hours to determine if a threshold has been crossed:

  - **Front End** — The following summed together:
    - Front end directors: % Busy, % Busy Port 0, % Busy Port 1 and
RDF directors: % Busy, % Busy Port 0

- **Cache** = % WP Utilization
- **Back End** = DA and DX: % Busy, % Busy Port 0, % Busy Port 1

Results are displayed in bar charts of the following colors:

- **Green**—Indicates the percent of checks that returned values below the first threshold.
- **Yellow**—Indicates the percent of checks that returned values between the first and second thresholds.
- **Red**—Indicates the percent of check that returned values above the second threshold.

Using the Home Dashboard on embedded installations

The contents of the Home Dashboard depend on the installation of Unisphere for VMAX you are using.

For more information about the standard Home Dashboard, refer to Using the Home Dashboard on page 32.

The **Home Dashboard** provides a single place from which you can quickly determine how your local storage system is performing. The **Home Dashboard** opens by default when you first open the console. To return to it from another view, click **Home Dashboard** in the menu bar.

**Note**

Storage systems appear grayed-out when they are in a disabled state. This usually occurs when the server managing the storage system is in the process of starting up.

**Note**

Systems with only a local storage system connected do not display the **Local** and **Remote** tabs. In that case, the panel is named **System** and displays information about the local system only.
The Home Dashboard displays the following panels, depending on your storage operating environment:

**Local/Remote**

By default, the Local tab is displayed. To view remote systems, click the Remote tab.

The Local tab displays the following information:

- System nice name, or if not defined, system ID number. Unlicensed systems are indicated with . To license the system, click the icon to open the Entitlements page where you can license the storage system.
  
  To open the system dashboard, click View System Dashboard.

- HYPERMAX OS — HYPERMAX OS version currently running on the local storage system. HYPERMAX OS versions below the minimum suggested target version display a warning icon . In this case, you should contact your service provider to schedule an upgrade.

- Type — Storage system model information.

- Alerts — A summary icon displaying the alert status and count. Alert status is indicated by icon color:
  
  - **— One or more fatal alerts.

  - ** — One or more critical alerts, with none higher.

  - ** — One or more warning alerts, with none higher.

  - ** — No alerts.

  To view details on the system's alerts, click the alert count to open the system's alert list view.

The Remote tab displays a table with the following information for each remote storage system:

- System nice name, or if not defined, system ID number.
  
  To view the system dashboard of the remote storage system, click the system name or number.

- Storage system model information.

- HYPERMAX OS version currently running on the remote storage system.

- Alert status and count. Alert status is indicated by icon color:

  - ** — One or more fatal alerts.

  - ** — One or more critical alerts, with none higher.

  - ** — One or more warning alerts, with none higher.

  - ** — No alerts.
To view details on the system's alerts, click the alert count to open the system's alert list view.

**Capacity**
Graphic representation of the system's subscribed and usable capacity (used = blue and free = grey) and the percentage used for both. **Overall Efficiency** is also displayed. This is the ratio of the sum of all TDEVs and Snapshot sizes and the Physical Used Storage (calculated based on the compressed pool track size). Click **View SRP Details** to open the storage system's SRP dashboard.

**Storage Group Compliance**
Displays how well the storage system's workload is complying with the overall service level. Storage groups compliance information displays for storage systems registered with the Performance component.

The total number of storage groups is listed, along with information about the number of storage groups performing according to service level targets. Possible values are:

- **Stable** — Number of storage groups performing within the service level targets. Indicates that there are no storage groups performing within the service level targets.

- **Marginal** — Number of storage group ps performing below service level targets. Indicates that there are no storage groups performing below service level targets.

- **Critical** — Number of storage groups performing well below service level targets. Indicates that there are no storage group performing well below service level targets.

To view the **Storage Groups Dashboard**, click **View Storage Group Dashboard**.

**System Utilization**
Displays a graphic representation of the distribution of % busy for the storage system's front-end, back-end, and cache partitions. Utilization information displays only for storage systems registered with the Performance component.

To calculate the % busy, the system runs through the following categories and metrics over four hours to determine if a threshold has been crossed:
Front End

The following summed together:

- Front end directors: % Busy, % Busy Port 0, % Busy Port 1
- RDF directors: % Busy, % Busy Port 0

Cache

% WP Utilization

Back End

DA and DX: % Busy, % Busy Port 0, % Busy Port 1

Results are displayed in bar charts of the following colors:

Green
Indicates the percent of checks that returned values below the first threshold.

Yellow
Indicates the percent of checks that returned values between the first and second thresholds.

Red
Indicates the percent of checks that returned values above the second threshold.

For system not registered with the Performance component, no information is displayed in the bar charts and they are colored gray. To register a storage system with the Performance component, click Register to View Performance Data.

Using the system selector

The system selector, located at the second left of the menu bar, displays a list of all managed storage systems. It allows you to toggle the interface between two modes, All Symmetrix and individual systems. The mode you select determines the menus/controls available to you (for example, the menus under All Symmetrix) and provide the context for subsequent operations.

For example, to create a host on SYMID001234:

1. Select SYMID001234 from the selector.
2. Select Hosts > Hosts > to open the Hosts list view.
3. Click Create to open the Create Host dialog box.
Discovering storage systems

Discovery refers to the process by which storage system, volume-level configuration and status information is retrieved. Discovered configuration and status data for all storage systems, as well as their directors and volumes, is maintained in a configuration database file on each host. Once you have discovered your environment, you can direct information requests to retrieve system level (high-level) data or volume-level (low-level) information from it.

To discover a storage system:

1. Click the system selector, located at the far left of the menu bar, and select Discover Symmetrix.
2. Click OK

Exporting data

This procedure explains how to export the contents of a view (list, details, dashboard, performance analyze) to a file:

Procedure

1. While in the view, click Export in the title bar and select Export to open the Export Wizard.
2. Expand Application Container and select the component to export.
3. Click Next.
4. Select whether to export the content as Data in a table or as an Image, or as Image and Data Table and click Next.
5. Select a format to use when exporting the data. The formats available here depend on whether you are exporting data or an image.
6. Click Finish.
7. Select a download location and click Save.

Refreshing console information

In the Unisphere console window, click in the status bar.
Unisphere for VMAX refreshes the data, visible in the current view, from its database.

Refreshing storage system information

Click in the status bar.
Unisphere for VMAX refreshes all of the storage system data from its database. This operation does not discover new storage systems, only refreshes data for existing systems.

Viewing product version information

Procedure
1. Select a storage system.
   - The following Solution Enabler properties display:
     • Connection Type
     • Net Connection Security Level
     • Net Protocol
     • Net Address
     • Net Port
     • Node Name
     • OS Type
     • OS Name
     • OS Version
     • OS Release
     • Machine Type
     • System Time
     • Num Symm Pdevs
     • SYMAP Build Version
     • SYMAP Runtime Version
     • Library Type
     • 64 bit Libraries
     • Multithread Libraries
Setting preferences

Procedure

1. Click in the title bar and select Settings.

2. Modify any of the following settings:
   - **Display Language**—Sets the language in which text is displayed in the interface. Only installed language packs are available.
   - **Logging Level**—Sets the logging level (All, Debug, Info, Warning, Error, or Fatal).
   - **Optimize for Remote Connection**—Select the checkbox to enable.

3. Click OK.

Searching for storage objects

This procedure explains how to search for objects (storage groups, hosts, initiators) across all manage storage systems.

Procedure

1. Click in the title bar.

2. Select the type of object (Storage Group, Host, Initiator).

3. Depending on the object you are looking for, type the following:
   - **Storage Group**—Type all or part of the storage group name.
   - **Host**—Type all or part of the host name.
   - **Initiator**—Type all or part of the initiator name.
• Select All Symmetrix or a specific storage system identifier.

4. Click Find.

Results include the object Name, the Object Type, and the associated storage system (Symmetrix ID).

5. To view object details, click the object name to open its Details view.

6. Click Clear to clear the results of the search.

Filtering lists of objects

Unisphere for VMAX includes two types of filtering tools to help you quickly locate specific objects in lists, wizards, and dialog boxes:

- **Simple**—Allows you search for specific objects by name. For example, the name of a storage group.

- **Advanced dialog**— Allows you to filter lists by attributes. For example, capacity, reservations, and so on.

---

**Note**

The system Audit Log and Alerts list views include their own custom filters. For instructions on using these filters, refer to Filtering audit log records on page 841 and Filtering alerts on page 53, respectively. In addition, the Volumes view for storage systems running HYPERMAX OS 5977 or higher includes another form of advanced filter. For instructions on using it, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203.

---

**Procedure**

1. Do one of the following:
   
   - To use the simple filter, click the filter icon and click Show Filter to display a search field.
     - Type all or part of the object's name and press Enter.
     - To clear the filter (that is, view the complete list again), click the filter icon again and select Clear.
   
   - To use the advanced filter, click the filter icon to open the Advanced Filter dialog box.
     - Select or type a value for any number of the following criteria, and then click OK.
     
       **Volume Type**
       
       - Capacity—Filters the list for volumes with a specific capacity.
       - Capacity Range—Filters the list for volumes with capacities within the range.
       - Volume Configuration—Filters the list for volumes with a specific configuration.
       - Advanced:
         
         - Emulation—Filters the list for volumes with a specific emulation.
– **Private Volumes**—Filters the list for volumes of a specific type.  
(This option is only available on storage systems running Enginuity 5773 or 5876.)

– **Meta**—Filters the list for metavolumes of a particular type.

– **Volume Flag**—Specifies any volume flags.

### Volume Identifier

– **Volume ID**—Filters the list for a volume with specific ID.

– **Volume Range**—Filters the list for volumes with IDs within the range.

– **Volume Identifier Name**—Filters the list for the specified volume name.

### Volume Availability

– **Status**—Filters the list for volumes with a specific status.

– **Reservation**—Filters the list for reserved volumes of a specific type.

– **Used:**

  – **Mapped**—Specifies whether to include/exclude mapped volumes.

  – **Masked**—Specifies whether to include/exclude masked volumes.

  – **Bound**—Specifies whether to include/exclude bound volumes.

  – **Enabled**—Specifies whether to include/exclude enabled volumes.

  – **Held**—Specifies whether to include/exclude held volumes.

– **In Storage Group**—Specifies whether to include/exclude volumes that are in storage groups.

– **In Device Group**—Specifies whether to include/exclude volumes that are in device groups.

– **AS400 Gatekeeper**—Specifies whether to include/exclude AS400 gatekeeper volumes.

– **Host Cache Card**—Specifies whether to include/exclude volumes under host cache card control.

– **D1F1**—Specifies whether to include/exclude volumes that do not have the d1f1 attribute set.

### Replication

– **SRDF group**—Filters the list for volumes within a specific SRDF group.

– **Dynamic RDF**—Filters the list for dynamic SRDF volumes of a specific type.

– **Used:**

  – **RecoverPoint**—Specifies whether to include/exclude volumes under RecoverPoint control. This option is only available on storage systems running Enginuity 5876.

  – **Write Pacing Capable**—Specifies whether to include/exclude volumes that are capable of using SRDF/A write pacing.

  – **Concurrent RDF**—Specifies whether to include/exclude volumes with the Concurrent RDF flag set.
– **Cascaded RDF** — Specifies whether to include/exclude volumes with the Cascaded RDF flag set. This option is only available on storage systems running Enginuity 5773 or 5876.

– **Diskless RDF** — Specifies whether to include/exclude volumes with the Diskless RDF flag set.

– **RDF not ready if Invalid** — Specifies whether to include/exclude volumes with the RDF_NR_IF_INV flag set.

– **RDF Asynchronous** — Specifies whether to include/exclude volumes with the RDF Asynchronous flag set.

– **Attached Target** — Specifies whether to include/exclude volumes with the Attached Target flag set.

– **Attached BCV** — Specifies whether to include/exclude volumes with the Attached BCV flag set.

– **Data Domain** — Specifies whether to include/exclude Data Domain volumes. This filter is only available on storage systems running HYPERMAX OS 5977 or higher.

**Related Objects**

– **Disk Technology** — Filters the list for volumes on a specific disk technology.

– **Pool** — Filters the list for volumes in a specific pool.

– **Disk Group** — Filters the list for volumes in a specific disk group.

– **Storage Group** — Filters the list for volumes in a specific storage group.

**Federated Tiered Storage**

---

**Note**

For storage systems running HYPERMAX OS 5977 or higher, this option is only available when using ProtectPoint.

---

– **Used:**

  – **External** — Specifies whether to include/exclude external volumes.

  – **Encapsulated** — Specifies whether to include/exclude encapsulated volumes.

  – **Encapsulated WWN** — Specifies whether to include/exclude volumes with encapsulated WWNs.

  – **Geometry Limited** — Specifies whether to include/exclude volumes with limited geometry.

**Virtual Provisioning**

– **Allocated Capacity Percentage** — Filters the list for volumes with a specific allocated capacity.

– **Written Capacity Percentage** — Filters the list for volumes with a specific written capacity.

– **Bound to Thin Pool** — Filters the list for volumes bound to specific thin pools.

To clear the filter, open the **Advanced Filter** dialog box, click **Clear All**, and then **OK**.
Modifying server logging levels

This procedure explains how to set the severity level of the alerts to log in the debug log. Once set, will only log events with the specified severity.

Procedure

1. Select All Symmetrix.
2. Select Support > Utilities > Modify Server Logging to open the Update Logging dialog box.
3. Select a Server Logging level and click OK.

Exiting the console

To exit the Unisphere for VMAX console, click in the title bar and select Logout. Click Log Out to confirm.

Getting help

Clicking in the title bar and selecting Help opens the entire help system.
Clicking help in a dialog box, wizard page, or view opens a help topic specifically for that dialog, page, or view.
Getting Started
CHAPTER 3

Administration

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Setting system preferences

Before you begin
Only a user with Administrator permission can set preferences.

Procedure
1. To set system preferences:
2. From the system selector, select All Symmetrix.
3. Select Home > Administration to open the Administration page.
4. Click Preferences to open the Preferences page.
5. Modify any number of the following preferences:

Debug
Specify the debug level. Set the following parameters:
- **Debug**—Set the level of debugging to write to the debug file.
- **Debug2**—Set the secondary level of debugging to write to the debug file.
- **Debug Filename**—Enter the debug file name.
- **Unisphere 360**—This setting enables or disables Unisphere 360 integration from the Unisphere side. Setting the checkbox to "disabled" prevents Unisphere 360 from being able to enroll this Unisphere and disconnects any instance of Unisphere 360 that had previously enrolled it.

Reservation
Specify storage system volume reservation preferences. Set the following parameters:

**Note**
Reservations must be enabled and enforced in the Options file, which is located in the SYMAPI configuration directory. The settings are displayed in the Reservation panel.

- **Enable Reservation**—Specifies whether volume reservations are enabled for this host.
- **Reservation Type**—Specifies whether a volume reservation is enforced for all users.
- **Default Reservation after expiration days**—Enter the number of days that volume reservations remain in affect. The value specified here appears as the default expiration date in all dialog boxes and wizard panels that include the Reserve option. Setting this value to 0 (default) disables this option and the Reserve option appears clear (unchecked) in all dialogs and wizard panels.

Select to enable or clear to disable for the following configuration parameters:
- **Enable acquire upon job starts**—Allows for automatic volume reservation on volumes for a job.
- **Enable require comments upon acquire**—Specifies that the user must enter comments for volume reservations. When enabled, the user must enter a comment, or an error displays.
- **Enable auto release after job completion**—Allows the volume reservation to be released after the job has been committed.

- **Enable auto release after clear**—Allows the volume reservation to be released after the task has been cleared from the job list.

**Replication**

Specify the following Replication parameters:

- **Mirror BCV Delay (sec)**—Select the amount of time to wait between TimeFinder® establish operations. The delay can be set from 0 to 30 seconds. The default value is 0.

- **Mirror BCV Establish Type**—Select the TimeFinder establish type.

- **Mirror BCV Pair Cancel Policy**—Select the BCV pair cancel policy for establishing new pairs when the maximum number of pairs has been reached.

- **Mirror Max BCV Pairs**—Select the maximum number of BCV pairs (0-16).

- **Clone Copy Mode**—Select the default behavior for creating clone sessions. Possible values are:
  - **No Copy No Diff**—Creates a nondifferential (full) copy session without a full background copy.
  - **Copy No Diff**—Creates a nondifferential (full) copy session in the background.
  - **PreCopy No Diff**—Creates a nondifferential (full) copy session in the background before the activate starts.
  - **Copy Diff**—Creates a differential copy session in the background. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume are copied).
  - **PreCopy Diff**—Creates a differential copy session in the background before the activate starts. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume are copied).
  - **VSE No Diff**—Creates a VP Snap Copy session.

- **Clone Pair Policy**—Select the clone terminate policy when establishing a new clone, and the maximum number of clones has been reached.

- **Automatic Clone Creation**—Select the mode in which to create the clone sessions. Possible values are:
  - **Best Effort**—Specifies to satisfy the request from existing volumes, and then create the volumes necessary to meet any shortfall.
  - **Find Existing**—Specifies to select from existing volumes.
  - **Create New**—Specifies to create new volumes.

- **Clone Target**—Select the default target volume.

- **Enable clone copy on write**—Restricts copy operations when the target of a clone is being read. Select to enable, or clear to disable.

- **Enable command scope**—Limits eligible volumes for TimeFinder operations to source volumes that have sessions with target volumes contained within the same device group. Enabling this option limits the eligible volumes. This option is only available on storage systems running Enginuity 5876 or higher. Select to enable, or clear to disable.
- **Enable multi virtual snap**—Allows for up to 128 snap sessions on the same source volume. For storage systems running Enginuity 5876 or higher, this also allows for the creation of multi-virtual snap sessions from thin volumes. Select to enable, or clear to disable.

- **Open Replicator Copy Mode**—Select the default behavior for creating Open Replicator copy sessions.

- **Snap Pair Policy**—Select the snap terminate policy for establishing a new snap when the maximum number of snaps has been reached.

- **Enable RDF group level consistency**—Allows for checks for consistency of the RDF group level during a consistent operation. Select to enable, or clear to disable.

- **Enable TF/Clone emulation**—Allows for TF/Clone emulation. Select to enable, or clear to disable.

- **Protection Setup Wizard SRDF Communication Protocol**—Select the default SRDF communication protocol, Fibre Channel or GigE.

- **Protection Setup Wizard SRDF Number of Ports**—Select the default number of ports to use with SRDF.

**SRDF/S Response Time (ms)**

Specify the threshold values used to determine the status (color) of the Remote Replication tile in the Protection Dashboard. For example, with the default values (Green = 5 and Yellow = 10) set, the following applies:

- When the response time of the majority of remotely protected device groups is less than 5, the status is green.
- When the response time of the majority of remotely protected device groups is less than 10, the storage group is yellow.
- When the response time of the majority of remotely protected device groups is more than 10, the storage group is red.

**Client Session**

Type a message to display to users during login. For example, you may want to notify logging in users about a software upgrade. Messages can be up to 240 characters.

5. Click **Apply**.

**Displaying login messages**

The login message feature enables Administrators and StorageAdmins to display a message to Unisphere for VMAX users during login. For example, an administrator may want to notify logging in users about a software upgrade.

To create a login message:

**Procedure**

1. From the system selector, select **All Symmetrix**.
2. Select **Home** > **Administration** > **Preferences**.
3. In the **Client Session** panel, type the message you want to display.

   Messages can be up to 240 characters.
Backing up the database server

Before you begin
To perform this operation, you must be an Administrator.

This procedure explains how to backup all the data currently on the database server, including Database Storage Analyzer, Workload Planner, performance, and infrastructure data. Database backups will enable you to recover from system crashes. You can only restore the database to the same version and same operating system. For example, a V8.0.1 database on Windows, can only be restored to a V8.0.1 on Windows.

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Databases to open the Databases list view.
3. Click Backup to open the Database Backup dialog box.
4. In File Name, type a description of the backup.
   Note that the final file name consists of a time stamp and your custom description.
5. Click OK.

Viewing database backups

Before you begin
To perform this operation, you must be a Monitor.

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Databases to open the Databases list view.
   The following properties display:
   • Backup Name—Name of the backup in the form TimeStamp_CustomName.
   • Status—Status of the backup.
   • Start Time—Time the backup started.
   • End Time—Time the backup ended.
   • Message—Message related to the backup.
   The following controls are available:
   • Backup—Backing up the database server on page 51
   • Delete—Deleting database backups on page 51

Deleting database backups

Before you begin
To perform this operation, you must be an Administrator.
Procedure

1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Databases.
3. Select one or more backups and click Delete.
4. Click OK.

Alert settings

You can configure Unisphere for VMAX to monitor storage systems for specific events or error conditions. When an event or error of interest occurs, Unisphere for VMAX displays an alert and, if configured to do so, notifies you of the alert by way of email, SNMP, or Syslog.

In addition to alerting you of specific events or errors, Unisphere for VMAX also performs a number of runtime checks that also alert you. For more information, refer to Runtime checks on page 67.

The procedures in this section explain how to configure and use the alert functionality.

Alerts

Viewing alerts

Before you begin

- For alert (event) descriptions, refer to the Events and Alerts Guide.
- In addition to alerting you of specific events or errors, Unisphere for VMAX also performs a number of runtime checks that also alert you. For more information, refer to Runtime checks on page 67.
- The maximum number of alerts Unisphere for VMAX displays is 10,000. Once this threshold is reached, Unisphere for VMAX deletes the oldest alert for each subsequent alert it receives.

This procedure explains how to view alerts for a particular storage system or all the visible storage systems.

Procedure

1. Do the following, depending on whether you want to view the alerts for a particular storage system, or for all storage systems.

   For a particular storage system:
   a. Select the storage system.
   b. Select System > Alerts to open the system’s Alerts list view.

   For all visible storage systems:
   a. Select All Symmetrix.
   b. Select Home > Alerts to open the Alert list view.

2. (Optional) Use the alert filter to view a subset of the listed alerts. For more information on the alert filter, refer to Filtering alerts on page 53.

   In both cases, the following properties display:
   - State—State of the alert. Possible values are New or Acknowledged.
• **Severity**—Severity of the alert. Possible values are:
  - Fatal
  - Critical
  - Warning—The following events map to this severity:
    - The component is in a degraded state of operation.
    - The storage array is no longer present (during certain operations).
    - The component is in an unknown state.
    - The component is (where possible) in a write-disabled state.
  - Information—The component is no longer present (during certain operations).
  - Normal—The component is now (back) in a normal state of operation.

• **Type**—Type of alert. Possible values are Array, Performance, Server, System, and File.

• **Symmetrix**—Storage system reporting the alert. This field only appears when viewing alerts for all Symmetrix systems. This field will appear blank for server alerts. This is because server alerts are specific to the server or runtime environment and are not associated with a specific object or storage system.

• **Object**—Component to which the alert is related. This is because server alerts are specific to the server or runtime environment and are not associated with a specific object or storage system.

• **Description**—Description of the alert.

• **Created**—Date/time the alert was created.

• **Acknowledged**—Date/time the alert was acknowledged.

The following controls are available:

• **View Details**—Viewing alert details on page 54.

• **Acknowledge**—Acknowledging alerts on page 54.

• **Delete**—Deleting alerts on page 55.

### Filtering alerts

**Procedure**

1. Select **System > Alerts**, or **Home > Alerts** to open the Alerts list view.

2. Use the filter tool to narrow the listed alerts to only those that meet the specified criteria:

   • **Start Date**—Filters the list for alerts created on the specified date/time.

   • **End Date**—Filters the list for alerts acknowledged on the specified date/time.

   • **State**—Filters the list for alerts with the specified state.
• **Severity**—Filters the list for alerts with the specified severity.

• **Type**—Filters the list for alerts with the specified type.

• **Object**—Filters the list for alerts for the specified object.

• **Description**—Filters the list for alerts with the specified description.

Acknowledging alerts

**Procedure**

1. Select the storage system.
2. Select **System > Alerts**.
3. Select one or more alerts and click **Acknowledge**.

Viewing alert details

**Procedure**

1. Select the storage system.
2. Select **System > Alerts**.
3. Select an alert and click **View Details** to open the Alerts Details view.

This view contains two panels, **Properties** and **Related Objects**.

**Properties** panel:

The following properties display:

**Alert ID**

Unique number assigned by Unisphere for VMAX.

**State**

State of the alert. Possible values are new or acknowledged.

**Severity**

Alert's severity. Possible values are:

- Fatal
- Critical
- Warning
- Information
- Normal

**Type**

Type of alert. Possible values are Array, Performance, and System.

**Symmetrix**

ID of the storage system generating the alert.

**Object**

Object to which the alert is related. For more information, click the object to open its details view.

**Created**

Date/time the alert was created.
Description

Description of the alert.

The following controls are available:

- **Acknowledge**—[Addressing alerts](#) on page 54.
- **Delete**—[Deleting alerts](#) on page 55.

**Related Objects** panel:

The **Related Objects** panel links you to other alerts related to the same object, if any. This panel displays only for Array alerts.

Deleting alerts

**Procedure**

1. Select the storage system.
2. Select **System > Alerts**.
3. Select one or more alerts and click **Delete**.

Configuring alert notifications

This procedure explains how to configure Unisphere for VMAX to notify you when a storage system generates an alert.

**Before you begin**

- To perform this operation, you must be an Administrator or StorageAdmin.
- Unisphere for VMAX employs the following throttling algorithms to prevent alert flurries from straining the system:

  **Storage system Event Throttling**
  
  When a storage system raises an alert flurry, the alert infrastructure packages all the alerts into a single notification.

  **Generic Throttling**
  
  When the number of alerts generated by a non-storage system event exceeds a set threshold, the alert infrastructure ignores subsequent alerts from the source.

- Alert notifications for runtime checks are not delivered. For more information on runtime checks, refer to [Runtime checks](#) on page 67.

**Procedure**

1. Do one of the following:
   
   - To enable alert notifications:
     
     a. From the **System Selector**, select **All Symmetrix**.
     b. Select **Home > Administration > Alert Settings > Notifications** to open the **Notifications** page.
     c. In the **Types** panel, click **Enable** next to the method you want to use to deliver the notifications. Possible methods are:

       **Syslog**
       
       Forwards alert notifications to a remote syslog server.

       **Email**
       
       Forwards alert notifications to an email address.
SNMP
Forwards alert notifications to a remote SNMP listener.

d. Depending on the method you selected, do the following:

- Syslog:
  Refer to Setting up the event daemon for monitoring in the Solutions Enabler Installation and Configuration Guide for instructions.

- Email:
  a. Type the email address of the email server (Sender Email).
  b. Type the IP address of the email server (IP Address/Host).
  c. If the port of your email server differs from the default (25), type a new value (Server Port).
  d. Type the email address to which notifications will be sent (Recipient Email).
  e. Optional: To send a test message to the email server, click Test.
  f. Click OK.

- SNMP:
  a. Optional: Click Add SNMP to add another SNMP server and click OK to confirm.
  b. Optional: Click X to remove a SNMP server and click OK to confirm.
  c. Type IP address of the SNMP server (IP Address/Host).
  d. Type the port on the SNMP server (Server Port).
  e. Optional: To send a test SNMP trap, click Test.
  f. Click OK.

e. In the Alerts panel, do the following for each storage system from which you want to receive notifications:

  a. Select the System Level and Performance Level severities in which you are interested.
  b. Type the email addresses to which the notifications should be sent.
  c. To clear your changes, click Discard.
  d. Once satisfied, click Save.

- To disable alert notifications:
  a. To disable alert notifications: From the System Selector, select All Symmetrix.
  b. Select Home > Administration > Alert Settings > Notifications to open the Notifications page.
  c. Click Disable next to method you no longer want to use.
Alert policies

Managing alert policies

Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.
- To receive alert notifications, you must first configure alert notifications.
- For alert (event) descriptions, refer to the Solutions Enabler Installation Guide.

Procedure

1. From the System Selector, select All Symmetrix.
2. Select Home > Administration > Alert Settings > Alert Policies.
3. Do one of the following:
   - To enable an alert policy:
     a. Select one or more alert policies, and click Enable.
     b. To receive a notification when a storage system reports an alert, click Notify to open the Define Notification dialog box.
     c. Select one or more notification types.
     d. Click OK.
   - To disable an alert policy:
     a. Select one or more alert policies, and click Disable.

Viewing alert policies

Procedure

1. From the System Selector, select All Symmetrix.
2. Select Home > Administration > Alert Settings > Alert Policies.

The following properties display:

- **Symmetrix ID**
  Storage system on which the policy is defined (for Array type policies) and an asterisk (*) for SMAS type policies.

- **Type**
  Type of alert policy. Possible values are:
  - **Array** for array-based alerts.
  - **SMAS** for application-based alerts.
  - **File** for eNAS-based alerts.

- **Policy Name**
  Name of the policy. For alert (event) descriptions, refer to the Solutions Enabler Installation Guide.

- **State**
  Whether the policy is Enabled or Disabled.
Notification
Icon indicating the method to use when delivering the alert notification (e-mail, SNMP, or Sys Log). A blank indicates that Unisphere for VMAX is not configured to deliver an alert notification for the corresponding policy.

The following controls are available:
- **Enable**—Managing alert policies on page 57
- **Disable**—Managing alert policies on page 57
- **Notify**—Configuring alert notifications on page 55

## Threshold alerts

### Managing threshold alerts

Certain alerts are associated with a numerical value. This value is compared with a set of threshold values, which determine whether the alert is delivered and, if so, with what severity. This procedure explains how to manage the alert threshold feature.

#### Before you begin
- For alert (event) descriptions, refer to the Events and Alerts Guide.
- Pool utilization thresholds are enabled by default on every storage system.
- To receive utilization threshold alerts, you must enable alerts on the storage system.
- To receive alert notifications, you must first configure the alert notifications feature.

#### Procedure

1. From the System Selector, select All Symmetrix.
2. Select Home > Administration > Alert Settings > Symmetrix Threshold Alerts.
3. Do the following, depending on whether you are creating, editing, or deleting thresholds:
   - Creating:
     a. Click Create.
     b. Select the storage system on which to create the threshold.
     c. Select the Category of threshold to assign.
     Possible values are:
     - **DSE Pool Utilization**
       Threshold event that reflects the allocated capacity (as percentage) within a DSE pool. This category only applies to Enginuity 5876.
     - **DSE Spill Duration**
       Threshold event that reflects how long (in minutes) an SRDF spillover has been occurring. This category only applies to Enginuity 5876.
     - **Snap Pool Utilization**
       Threshold event that reflects the allocated capacity (as percentage) within a snap pool. This category only applies to Enginuity 5876.
Thin Pool Utilization  
Threshold event that reflects the allocated capacity (as percentage) within a virtual pool.

FAST VP Policy Utilization  
Threshold event that reflects the allocated capacity (as percentage) of all the pools in all the tiers in a FAST VP policy. This category only applies to Enginuity 5876.

Storage Resource Pool Utilization  
Threshold event that reflects the allocated capacity (as percentage) within an SRP. This category only applies to storage systems running HYPERMAX OS 5977 or higher.

Local Replication Utilization  
Threshold event that indicates that the local replication resource usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2016 SR or higher.

System Meta Data Utilization  
Threshold event that indicates that the system meta data Utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2017 SR or higher.

Storage Container Utilization  
Threshold event that indicates that the storage container utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 or higher.

d. Select the pools (Instances to enable) on which to create the threshold.
e. Specify a threshold value (percentage of utilization) for each severity level: Warning, Critical, and Fatal.
f. Click OK.

Editing:
• Select a threshold and click Edit.
• Specify a new threshold value (percentage of utilization) for any number of the severity levels: Warning, Critical, and Fatal.
• Enable (select) or disable (clear) alerts for the threshold.
• Click OK.

Deleting:
• Select one or more thresholds and click Delete.

Viewing threshold alerts

Before you begin
• For alert (event) descriptions, refer to the Events and Alerts Guide.

Procedure
1. From the System Selector, select All Symmetrix.
2. Select Home > Administration > Alert Settings > Symmetrix Threshold Alerts to open the Symmetrix Threshold Alerts list view.
   The following properties display:
• **Symmetrix ID**—Storage system on which the threshold is defined.

• **Category**—Category on which the threshold is defined. Possible values are:
  - **DSE Pool Utilization**—Threshold event that reflects the allocated capacity (as percentage) within a DSE pool.
  - **DSE Spill Duration**—Threshold event that reflects how long (in minutes) an SRDF spillover has been occurring.
  - **Snap Pool Utilization**—Threshold event that reflects the allocated capacity (as percentage) within a snap pool.
  - **Thin Pool Utilization**—Threshold event that reflects the allocated capacity (as percentage) within a virtual pool.
  - **FAST VP Policy Utilization**—Threshold event that reflects the allocated capacity (as percentage) of all the pools in all the tiers in a FAST VP policy.
  - **Local Replication Utilization**—Threshold event that indicates that the local replication resource usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2016 SR or higher.
  - **System Meta Data Utilization**—Threshold event that indicates that the system meta data Utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2017 SR or higher.
  - **Storage Container Utilization**—Threshold event that indicates that the storage container utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 or higher.
  - **Storage Resource Pool Utilization**—Threshold event that reflects the allocated capacity (as percentage) within an SRP. This category only applies to storage systems running HYPERMAX OS 5977 or higher.

• **Instance**—Pool on which the threshold is defined. An asterisk (*) indicates that the default pool type was used.

• **State**—Whether the policy is Enabled or Disabled.

• **Notification**—Whether the alert notification option is enabled or disabled for the alert.

• **Warning**—Percentage of utilization at which point a warning alert is issued.

• **Critical**—Percentage of utilization at which point a critical alert is issued.

• **Fatal**—Percentage of utilization at which point a fatal alert is issued.

• **Custom**—Whether the policy has been customized.

The following controls are available:

• **Create**—Managing alert policies on page 57

• **Edit**—Managing alert policies on page 57

• **Notify**—Configuring alert notifications on page 55

• **Delete**—Managing alert policies on page 57
Performance thresholds and alerts

Creating a performance threshold and alert

You can use the default system values for thresholds and alerts, or create your own. When you set threshold values, you can optionally view them when you create charts for performance metrics in the Root Cause Analysis view.

To create a threshold or an alert:

Procedure

1. Select **Performance > Settings > Performance Thresholds and Alerts**.
2. Click **Create**.
3. Select the **Symmetrix ID, Category, Instance**, and **Metric**.
   - For some categories, when selected, the **Instance** field defaults to **All**.
   - If there is a default value for the Metric, it automatically displays in the **First Threshold** and **Second Threshold** fields.
4. Add a value for the **First Threshold**, **Second Threshold**, or both.
5. Threshold creation only: Click **OK**.
6. To add an alert for the threshold, complete the following steps:
   a. Click **Enable Alert**.
   b. Select the severity for the first threshold, the second threshold, or both.
      The available values are **Information**, **Warning**, and **Critical**.
   c. Set the number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.
   d. (Optional) Select any additional configuration options. For some group categories, you can choose to enable for the alert for the individual components of the group, for example, when the **Disk Group** category is selected, you have the option to enable the alert for the disk.
   e. Click **OK**.

Editing a performance threshold and alert

When you edit a threshold and alert setting, a symbol displays in the **Custom** column of the alerts list to indicate that the value has changed from the default.

To edit performance thresholds and alerts:

Procedure

1. Select **Performance > Settings > Performance Thresholds and Alerts**.
2. Navigate to the threshold or alert to be edited by selecting the appropriate category in the **Category** section and expanding the appropriate metric in the **Metric** column.
3. Select the item from the table and click **Edit**.
4. Edit the threshold and alert settings, as appropriate.
5. Click **OK**.
Deleting performance thresholds and alerts

Before you begin
You can delete only custom values. You cannot delete default thresholds.

To delete a performance threshold and alert:

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Navigate to the threshold or alert to be edited by selecting the appropriate category in the Category section and expanding the appropriate metric in the Metric column.
3. Select one or more rows and click Delete.
4. In the Delete Threshold and Alert confirmation dialog box, click Delete.

Viewing thresholds and alerts

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Select a storage system.
3. In the Category section, select the category for which you want to view the configured thresholds and alerts.

The thresholds and alerts configured for that category are displayed, according to metric. By default, the KPI tab displays. To view all metrics, click All.

Any metrics that include a custom threshold or alert are highlighted with a tick mark in the Custom column.

The following properties display:
- Metric — The storage system identifier.
- KPI — Indicates (with a tick mark) if the metric is a KPI.
- Custom — Indicates (with a tick mark) whether a custom threshold or alert has been set.
- First Threshold — The user-defined first threshold.
- Second Threshold — The user-defined second threshold.

Configuring email notification

You can configure email addresses to which notifications, alerts, and reports are sent. You can configure a single email address for all notification instances, or you can use different email addresses for different notifications on different storage systems.

To set up email notification:

Procedure
1. Do one of the following:
   - To set up email notification:
     - Click Home > Administration > Alert Settings > Notifications.
     - In the Email section, click Enable.
In the From section specify the following details:
- Sender Email
- IP Address/Host
- Server Port

In the Recipient Email field of the To section, specify the address you want to enable for all email notifications.

Click OK.

To add an email address and apply it to all notification instances:
- Click Home > Administration > Alert Settings > Notifications.
- In the Email section, click Enable.
- In the Recipient Email field of the To section, specify the address you want to enable for all email notifications.

Note
If you configure a new email address in this way, any previously configured addresses are overwritten.

Click OK.

To configure email addresses for individual notifications:
- Click Home > Administration > Alert Settings > Notifications.
- Click the Edit icon for the storage system for which you want to edit the email notification settings. The three individual email fields become editable.
- Configure the email addresses for individual notifications, as appropriate.
- Optional: Configure the notification levels by clicking the appropriate icons in the System Level and Performance Level columns.
- Click OK.

Service level alert policies

Creating service level compliance alerts policies

This procedure explains how to configure Unisphere for VMAX to alert you when the performance of a storage group, relative to its service level target, changes. Once configured, Unisphere for VMAX will assess the performance of the storage every 30 minutes, and deliver the appropriate alert level.

When assessing the performance for a storage group, Workload Planner calculates its weighted response time for the past 4 hours and for the past 2 weeks, and then compares the two values to the maximum response time associated with its given service level. If both calculated values fall within (under) the service level defined response time band, the compliance state is STABLE. If one of them is in compliance and the other is out of compliance, then the compliance state is MARGINAL. If both are out of compliance, then the compliance state is CRITICAL.

The following table details the state changes that will generate an alert and the alert level.
Table 1 Service level compliance rules

<table>
<thead>
<tr>
<th>State change</th>
<th>Alert generated</th>
<th>Alert level</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY STATE &gt; NONE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NONE &gt; STABLE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NONE &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>NONE &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>STABLE &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>STABLE &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>STABLE &gt; STABLE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>MARGINAL &gt; STABLE</td>
<td>Yes</td>
<td>Info</td>
</tr>
<tr>
<td>MARGINAL &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>MARGINAL &gt; MARGINAL</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>CRITICAL &gt; STABLE</td>
<td>Yes</td>
<td>Info</td>
</tr>
<tr>
<td>CRITICAL &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>CRITICAL &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
</tbody>
</table>

Note
When a storage group configured for compliance alerts is deleted or renamed, the compliance alerts will need to be deleted manually. For instructions, refer to Deleting compliance alerts policies on page 65.

Before you begin
- The storage system must be running HYPERMAX OS 5977 or higher and registered for performance stats collection.
- The storage group must:
  - Be either a child or standalone. Parent storage groups are not supported.
  - Be associated with a service level other than optimized.
  - Contain volumes other than gatekeepers.
  - Be in a masking view.
  - Not have a policy currently associated with it.

To create service level compliance alert policies:

Procedure
1. From the System Selector, select All Symmetrix.
2. Select Home > Administration > Alert Settings > Compliance Alert Policies
3. Click Create.
4. Select the storage system on which the storage groups are located.
5. Select one or more storage groups and click Add.
6. (Optional) By default, service level compliance policies are configured to generate alerts for all service level compliance states. To change this default behavior, clear any of the states for which you do not want generate alerts:

- **Critical**—Storage group performing well below service level targets.
- **Marginal**—Storage group performing below service level target.
- **Stable**—Storage group performing within the service level target.

7. Click OK.

### Editing compliance alerts policies

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. From the **System Selector**, select **All Symmetrix**.
2. Select **Home > Administration > Alert Settings > Compliance Alert Policies**.
3. Select the policy, and then select (enable) or clear (disable) any of the **Compliance States**.

Unisphere for VMAX generates alerts only for enabled compliance states.

4. Click **Apply**.

### Deleting compliance alerts policies

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. From the **System Selector**, select **All Symmetrix**.
2. Select **Home > Administration > Alert Settings > Compliance Alert Policies**.
3. Select one or more policies and click **Delete**.
4. Click **OK**.

### Viewing compliance alerts policies

This procedure explain how to view compliance alert polices set on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. From the **System Selector**, select **All Symmetrix**.
2. Select **Home > Administration > Alert Settings > Compliance Alert Policies**.  

The following properties display:

- **Symmetrix ID** — Storage system on which the policy is defined.
- **Storage Group** — Storage group on which the policy is defined.
- **Compliance State** — Enabled compliance states:
Critical — Storage group performing well below service level targets

Marginal — Storage group performing below service level target.

Stable — Storage group performing within the service level target.

Notification — Method to use when delivering the alert notification (e-mail, SNMP, or Sys Log). A blank indicates that Unisphere for VMAX is not configured to deliver an alert notification for the corresponding policy.

The following controls are available:

- Create — Creating service level compliance alerts policies on page 63
- Notify — Configuring compliance alert notifications on page 66
- Delete — Deleting compliance alerts policies on page 65
- Apply — Applies policy changes.
- Cancel — Cancels policy changes.

Configuring compliance alert notifications

This procedure explains how to configure Unisphere for VMAX to notify you when a storage group generates a compliance alert.

Before you begin

- The storage system must be running HYPERMAX OS 5977 or higher.
- The storage system must be configured to deliver alert notifications, as described in Configuring alert notifications on page 55.

Procedure

1. From the System Selector, select All Symmetrix.
3. Select one or more policies and click Notify.
4. Select (enable) the method you want to use to deliver the notifications. Possible methods are:
   - Enable Email — Forwards alert notifications to an email address.
   - Enable SNMP — Forwards alert notifications to a remote SNMP listener.
   - Enable Syslog — Forwards alert notifications to a remote syslog server.

   Note

   The storage system must already be configured to deliver alerts in the desired method, as described in Configuring alert notifications on page 55.

5. Click OK.
Runtime checks

Unisphere for VMAX performs the following runtime checks. If a check returns a result outside the expected range, Unisphere for VMAX raises the appropriate alert.

Checks are run on 10 minute intervals and alerts are raised on 24 hour intervals from the time the server was last started. Note that these time intervals also apply to discover operations. That is, performing a discover operation will not force the delivery of these alerts.

Note

Runtime check alerts are not sent in alert notifications. For more information on alert notifications, refer to Configuring compliance alert notifications on page 66.

Note

Runtime alerts are not storage system-specific and therefore cannot be acknowledged or deleted.

<table>
<thead>
<tr>
<th>Runtime check</th>
<th>Number of volumes</th>
<th>Threshold</th>
<th>Alert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total memory on the Unisphere for VMAX server</td>
<td>0 - 64,000</td>
<td>12 GB</td>
<td>System memory &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td></td>
<td>64,000 - 128,000</td>
<td>16 GB</td>
<td>System memory &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td></td>
<td>128,000 - 256,000</td>
<td>20 GB</td>
<td>System memory &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td>Free disk space on the Unisphere for VMAX installed directory</td>
<td>0 - 64,000</td>
<td>100 GB</td>
<td>Free disk space &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td></td>
<td>64,000 - 128,000</td>
<td>140 GB</td>
<td>Free disk space &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td></td>
<td>128,000 - 256,000</td>
<td>180 GB</td>
<td>Free disk space &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td>Number of managed storage systems</td>
<td>Threshold is 20.</td>
<td></td>
<td>Number of managed arrays &lt;#&gt; is over the maximum supported number of #</td>
</tr>
<tr>
<td>Number of managed volumes</td>
<td>256,000</td>
<td></td>
<td>Number of managed volumes &lt;#&gt; is over the maximum supported number of #</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note that Solutions Enabler may indicate a slightly different number of volumes than indicated in this alert.</td>
</tr>
<tr>
<td>Number of gatekeepers</td>
<td>6</td>
<td></td>
<td>Number of gatekeepers &lt;#&gt; on Symmetrix (SymmID) is below the minimum requirement of 6.</td>
</tr>
</tbody>
</table>
Security

Initial setup user warning message

When Unisphere for VMAX is first installed, there is a single user called the Initial Setup User (ISU). This user can perform administrative tasks only on storage systems that do not have defined roles (authorization rules). Once an Administrator or Security is assigned to a storage system, the ISU will no longer be able to access or even see the system from the Unisphere console. Therefore, it is recommended that users not operate in this role for too long. The main tasks of the ISU are the creation of local users and authorization rules.

When logging in to Unisphere for VMAX as the Initial Setup User (ISU), the "Initial setup user warning" message is displayed and it informs you that you can only access the listed storage systems because they do not have defined authorization rules. Once rules are defined for the storage systems, you will no longer be able to access or view the storage systems as the ISU.

To continue to access/view a Symmetrix system while operating as the ISU, select the corresponding Assign Admin role to ISU option and click OK.

For more information on operating as the ISU, refer to the Unisphere for VMAX Installation Guide.

Authentication

Login authentication

When you log in, Unisphere for VMAX checks the following locations for validation:

- **Windows** — The user has a Windows account on the server. (Log in to Unisphere for VMAX with your Windows Domain\Username and Password.)

- **LDAP-SSL** — The user account is stored on an LDAP-SSL server. (Log in to with your Unisphere LDAP-SSL Username and Password.) The Unisphere Administrator or SecurityAdmin must set the LDAP-SSL server location in the LDAP-SSL Configuration dialog box.

- **Local** — The user has a local Unisphere account. Local user accounts are stored locally on the Unisphere for VMAX server host. (Log in to Unisphere for VMAX with your Username and Password.)

The Initial Setup User, Administrator, or SecurityAdmin must create a local Unisphere for VMAX user account for each user.

Configuring authentication authorities

Before you begin

- If configuring authentication to use LDAP, obtain the LDAP-SSL server bind distinguished name (DN) and password from your LDAP Administrator.

This procedure explains how to configure Unisphere for VMAX to authenticate users.

To configure authentication:

Procedure

1. Select All Symmetrix.
2. Select Home > Administration > Security > Authentication.
3. Click **Edit** to open the **Configure Authentication** wizard.

4. Select the **Authentication Authority** to use during login. Possible values are:
   - **Local Directory** — When enabled, users can log in as a user from the CST local directory.
   - **LDAP-SSL** — When enabled, users can log in as a user from the configured LDAP directory.
   - **Windows OS/AD** — When enabled, users can log in as a user from the Windows local host and/or from the Active Directory domain. This option only applies to Windows installations.

5. If you selected the Windows OS/AD authority, as an option you can specify to limit authentication to members of a specific Windows OS/AD group. To do this, click **Show Advanced**, select the option, and type the **Group Names**, separated by commas.

6. Click **Next**.

7. If you are configuring LDAP-SSL, do the following:
   a. Specify values for the following parameters and click **Next**.
      - **Server (IP or Hostname)** — IP address or hostname of the LDAP server to use for authentication. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.
      - **Port** — Port number of the LDAP service. Typically, this value is 389 for LDAP and 636 for LDAPS. Valid values range from 1 through 65,535.
      - **Bind DN** — Distinguished name of the privileged account used to perform operations, such as searching users and groups, on the LDAP directory. Only alphanumeric characters are allowed. Values longer than 60 characters will wrap.
      - **Bind Password** — Password of the privileged account. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
      - **User Search Path** — Distinguished name of the node at which to begin user searches. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.
      - **User Object Class** — Object class identifying users in the LDAP hierarchy. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
      - **User ID Attribute** — Attribute identifying the user login ID within the user object. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
      - **Group Search Path** — Distinguished name of the node at which to begin group searches. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.
      - **Group Object Class** — Object class identifying groups in the LDAP hierarchy. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
      - **Group Name Attribute** — Attribute identifying the group name. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
      - **Group Member Attribute** — Attribute indicating group membership for a user within the group object. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.
b. Optional: To upload an SSL certificate, click **Browse**, locate the certificate, and click **Open**. To view the contents of the certificate, click **View Certificate**.

c. Optional: To limit authentication to only members of specific LDAP groups, click **Show Advanced**, select the option, and then type the **Group Names**, separated by commas.

d. Click **Next**.

8. Verify your selections in the **Summary** page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.

9. Click **Finish**.

**Viewing authentication authorities**

**Procedure**

1. Select **All Symmetrix**.

2. Select **Home > Administration > Security > Authentication** to open the **Authentication** page.

   Use the **Authentication** page to view and manage authentication settings. The following properties display:

   **Authentication Authority States**
   - **Local Directory**—When enabled, users can log in as a user from the CST local directory.
   - **Windows OS/AD**—When enabled, users can log in as a user from the Windows local host and/or from the Active Directory domain. This property only displays for Windows installations.
   - **LDAP-SSL**—When enabled, users can log in as a user from the configured LDAP directory.

   **LDAP Details** (Only displays if LDAP is enabled.)
   - **Server**—Hostname of IP address of the LDAP server used for authentication.
   - **Port**—Port number of the LDAP service. Typically, this value is 389 for LDAP and 636 for LDAPS.
   - **Bind DN**—Distinguished name (DN) of the privileged account used to perform operations, such as searching users and groups, on the LDAP directory.
   - **User Search Path**—Distinguished name of the node at which to begin user searches.
   - **User Object Class**—Object class identifying users in the LDAP hierarchy.
   - **User ID Attribute**—Attribute identifying the user login ID within the object.
   - **Group Search Path**—Distinguished name of the node at which to begin group searches.
   - **Group Object Class**—Object class identifying groups in the LDAP hierarchy.
   - **Group Name Attribute**—Attribute identifying the group name.
   - **Group Member Attribute**—Attribute indicating group membership for a user within the group object.
Understanding user authorization

User authorization is a tool for restricting the management operations users can perform on a storage system or with the Database Storage Analyzer application. By default, user authorization is enabled for Unisphere users, regardless of whether it is enabled on the Symmetrix system.

When configuring user authorization, an Administrator or SecurityAdmin maps individual users or groups of users to specific roles on storage systems or Database Storage Analyzer, which determine the operations the users can perform. These user-to-role-to-storage system/Database Storage Analyzer mappings (known as authorization rules) are maintained in the symauth users list file, which is located on either a host or storage system, depending on the storage operating environment.

Note

If there is one or more users listed in the symauth file, users not listed in the file are unable to access or even see storage systems from the Unisphere console.

Roles

The following lists the available roles. Note that you can assign up to four of these roles per authorization rule. For a more detailed look at the permissions that go along with each role, see Roles and associated permissions on page 79.

- **None**—Provides no permissions.
- **Monitor**—Performs read-only (passive) operations on a storage system excluding the ability to read the audit log or Access Control definitions.
- **StorageAdmin**—Performs all management (active or control) operations on a Symmetrix system and modifies GNS group definitions in addition to all Monitor operations
- **Administrator**—Performs all operations on a storage system, including security operations, in addition to all StorageAdmin and Monitor operations.
- **SecurityAdmin**—Performs security operations on a Symmetrix system, in addition to all Monitor operations.
- **Auditor**—Grants the ability to view, but not modify, security settings for a Symmetrix system, (including reading the audit log, symacy list and symauth) in addition to all Monitor operations. This is the minimum role required to view the Symmetrix audit log.
- **DSA Admin**—Collects and analyzes database activity with Database Storage Analyzer.

A user cannot change their own role so as to remove Administrator or SecurityAdmin privileges from themselves.

In addition to these user roles, Unisphere includes an administrative role, the Initial Setup User. This user, defined during installation, is a temporary role that provides administrator-like permissions for the purpose of adding local users and roles to Unisphere. For more information, see Operating as the initial setup user on page 28.
Individual and group roles

Users gain access to a storage system or component either directly through a role assignment and/or indirectly through membership in a user group that has a role assignment. If a user has two different role assignments (one as an individual and one as a member of a group), the permissions assigned to the user will be combined. For example, if a user is assigned a Monitor role and a StorageAdmin role through a group, the user is granted Monitor and StorageAdmin rights.

User IDs

Users and user groups are mapped to their respective roles by IDs. These IDs consist of a three-part string in the form:

Type:Domain\Name

Where:

- **Type**—Specifies the type of security authority used to authenticate the user or group. Possible types are:
  - **L** — Indicates a user or group authenticated by LDAP. In this case, Domain specifies the domain controller on the LDAP server. For example:
    
    L:danube.com\Finance

    Indicates that user group Finance logged in through the domain controller danube.com.
  - **C** — Indicates a user or group authenticated by the Unisphere server. For example:
    
    C:Boston\Legal

    Indicates that user group Legal logged in through Unisphere sever Boston.
  - **H** — Indicates a user or group authenticated by logging in to a local account on a Windows host. In this case, Domain specifies the hostname. For example:
    
    H:jupiter\mason

    Indicates that user mason logged in on host jupiter.
  - **D** — Indicates a user or group authenticated by a Windows domain. In this case, Domain specifies the domain or realm name. For example:
    
    D:sales\putman

    Indicates user putman logged in through a Windows domain sales.

- **Name**—specifies the username relative to that authority. It cannot be longer than 32 characters and spaces are allowed if delimited with quotes. Usernames can be for individual users or user groups.

Within role definitions, IDs can be either fully qualified (as shown above), partially qualified, or unqualified. When the Domain portion of the ID string is an asterisk (*), the asterisk is treated as a wildcard, meaning any host or domain.

When configuring group access, the Domain portion of the ID must be fully qualified. For example:

- **D:ENG\jones**—Fully qualified path with a domain and username (for individual domain users).
- **D:ENG.xyz.com\ExampleGroup**—Fully qualified domain name and group name (for domain groups).
- **D:*\jones**—Partially qualified that matches username jones with any domain.
- `H:HOST\jones`—Fully qualified path with a hostname and username.
- `H:*\jones`—Partially qualified that matches username jones within any host.
- `jones`—Unqualified username that matches any jones in any domain on any host.

In the event that a user is matched by more than one mapping, the user authorization mechanism uses the more specific mapping. If an exact match (for example, `D:sales\putman`) is found, that is used; if a partial match (for example, `D:*\putman`) is found, that is used; if an unqualified match (for example, `putman`) is found, that is used; otherwise, the user is assigned a role of None.

**Authorization**

**Adding authorization rules**

**Before you begin**

- To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin.

To add authorization rules:

**Procedure**

1. Select **All Symmetrix**.
2. Select **Home > Administration > Security > Authorized Users & Groups**.
3. Click **Add** to open the **Add Authorization Rule** dialog box.
4. Optional: Select an authentication **Authority**. Possible values are:
   - **Local Directory**—Specifies to authenticate the user against the Local Authority repository.
   - **Windows AD**—Specifies to authenticate the user against the Active Directory domain.
   - **LDAP-SSL**—Specifies to authenticate the user against an LDAP directory.
5. Do the following depending on the authority:
   - **Local Directory**:
     - Select the user **Name**.
   - **Windows AD** or **LDAP-SSL**
     a. Specify whether the rule is for an individual **User** or for a user **Group**.
     b. Optional: Type the name of the **Domain** used to authenticate the user/group. Possible values are based on the authentication authority:

<table>
<thead>
<tr>
<th>Authority</th>
<th>Domain Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local directory</td>
<td>Unisphere server hostname</td>
</tr>
<tr>
<td>Windows OS</td>
<td></td>
</tr>
<tr>
<td>Windows AD</td>
<td>Unisphere server domain</td>
</tr>
<tr>
<td>LDAP-SSL</td>
<td>LDAP server domain</td>
</tr>
</tbody>
</table>

c. Type the **Name** of the user or group. User/group names can only contain alphanumeric characters.
6. For **Database Storage Analyzer**, select **None**, **Read Only**, or **Admin**. By default, **Database Storage Analyzer** permissions are set to **None**.
7. On the Roles tab, select the object and up to four roles.

8. Click the Show only VMAX with hinting enabled checkbox to see the list of storage system with hinting enabled.
   The storage system must be running HYPERMAX 5977 or higher.

9. Click the DSA Hinting role. This role is only enabled for DSA administrators.

10. Click OK.

**Editing authorization rules**

**Before you begin**

- To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin on all authorized storage systems.

To modify authorization rules:

**Procedure**

1. Select All Symmetrix.
2. Select Home > Administration > Security > Authorized Users & Groups.
3. Select a rule and click Edit to open the Edit Authorization Rule dialog box.
4. On the Roles tab, add or remove from any of the available objects, being sure to not exceed the four roles/object limit.
5. Click OK.

**Removing authorization rules**

**Before you begin**

To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin on all authorized storage systems.

To remove authorization rules:

**Procedure**

1. Select All Symmetrix.
2. Select Home > Administration > Security > Authorized Users & Groups.
3. Select the rule and click Remove.
4. Click OK.

**Viewing authorization rules**

**Procedure**

1. Select All Symmetrix.
2. Select Home > Administration > Security > Authorized Users & Groups to open the Authorized Users & Groups list view.

Use the Authorized Users & Groups list view to view and manage authorization rules.

The following properties display:

- **Name**—User or group name.
- **Authority**—Authentication authority. Possible values are:
  - **Local Directory**—Directory of users and encrypted passwords stored in a CST .xml file (users only, no groups).
- **Windows OS**—Local Windows users and groups.
- **Windows AD**—Windows Active Directory users and groups that are accessed through the SMAS server's domain.
- **LDAP-SSL**—Users and groups on LDAP server that have been configured the Configure Authorization wizard.
- **Unsupported**—Not supported.

- **Authentication Domain**—Domain name. Possible values are based on the authentication authority:

<table>
<thead>
<tr>
<th>Authority</th>
<th>Domain name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local directory</td>
<td>Unisphere server hostname</td>
</tr>
<tr>
<td>Windows OS</td>
<td></td>
</tr>
<tr>
<td>Windows AD</td>
<td>Unisphere server domain</td>
</tr>
<tr>
<td>LDAP-SSL</td>
<td>LDAP server domain</td>
</tr>
<tr>
<td>Virtualization domain</td>
<td>Virtualization domain</td>
</tr>
<tr>
<td>Any authority</td>
<td>Any</td>
</tr>
</tbody>
</table>

The following controls are available:

- **Add**—Adding authorization rules on page 73
- **Remove**—Removing authorization rules on page 74
- **Edit**—Editing authorization rules on page 74

**View Certificate dialog box**

Use this dialog box to view contents of an SSL certificate.

**Local Users**

**Creating local users**

**Before you begin**

To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on at least one storage system.

This procedure explains how to create local users. Local users have accounts stored locally in the user database in the Unisphere server host.

To create local users:

**Procedure**

1. Select **All Symmetrix**.
2. Select **Home > Administration > Security > Local Users**.
3. Click **Create** to open the **Add Authorization Rule** dialog box.
4. Type a **User Name**.

   User names are case-sensitive and can only contain alphanumeric characters.
5. Optional: Type a **Description**.
6. Type and confirm a user **Password**.
   Passwords cannot exceed 16 characters. There are no restrictions on special characters when using passwords. However, these characters should not be used when creating user names: `\`, ``, `:`.

7. For **Database Storage Analyzer** select **None**, **Read Only**, or **Admin**.
   By default, **Database Storage Analyzer** permissions are set to **None**.

8. Click the **Roles** tab, select the object and up to four .

9. Click the **Show only VMAX with hinting** enabled checkbox to see the list of storage systems with hinting enabled.
   The storage system must be running HYPERMAX 5977 or higher.

10. Click the **DSA Hinting** role.
    This role is only enabled for DSA administrators.

11. Click OK.

**Editing local users**

**Before you begin**
- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on all authorized storage systems.
- Users cannot remove the **SecurityAdmin** role from themselves.

This procedure explains how to edit the roles associated with a user or group.

**To create local users:**

**Procedure**
1. Select **All Symmetrix**.
2. Select **Home > Administration > Security > Local Users**.
3. Select a user and click **Edit** to open the **Properties** dialog box.
4. Optional: Type a new **Description**.
5. On the **Roles** tab, add or remove from any of the available objects, being sure to not exceed the four roles/object limit.
6. Click **OK**.

**Deleting local users**

**Before you begin**
- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on all authorized storage systems.
- Users cannot remove the SecurityAdmin role from themselves.

This procedure explains how to delete local users and all fully-qualified authorization rules (rules in the format `L:HostName\UserName`).

**To delete a user:**

**Procedure**
1. Select **All Symmetrix**.
2. Select **Home > Administration > Security > Local Users.**

3. Select the user and click **Delete** to open the **Delete Local User** dialog box.

4. Optional: By default, deleting local users removes their associated authorization rules from all objects, including storage systems and the Database Storage Analyzer database. To override this default behavior, select the **Remove associated authorization** rules option.

5. Click **OK.**

### Changing local user passwords

**Before you begin**

- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on at least one storage system.

This procedure explains how to change a local user passwords.

To change local directory user passwords:

**Procedure**

1. Select **All Symmetrix.**
2. Select **Home > Administration > Security > Local Users.**
3. Select a user and click **View Details.**
4. Click **Change Password** to open the **Change Password** dialog box.
5. Type the user's **Current Password.**
6. Type a **New Password** and **Confirm New Password.**
7. Click **OK.**

### Viewing local users

**Before you begin**

- To perform this operation, you must be the Initial Setup User (set during installation), or Monitor on at least one storage system.

To view users with a local Unisphere account:

**Procedure**

1. Select **All Symmetrix.**
2. Select **Home > Administration > Security > Local Users** to open the **Local Users** list view.
3. The **Local Users** list view to allows you to view and manage local users.
   - The following properties display:
     - **User Name**—User or group name.
     - **Description**—Optional description.
   - The following controls are available:
     - **Create**—Creating local users on page 75.
     - **View Details**—Viewing local users details on page 78.
     - **Delete**—Deleting local users on page 76.
Viewing local users details

This procedure explains how to view the details of a local user.

Procedure

1. Select All Symmetrix.
2. Select Home > Administration > Security > Local Users.
3. Select a user and click View Details to open its Details view.

The Details view allows you to view and manage a local user. It contains Properties and Related Objects panels.

Properties panel:

The following properties display:

- User Name—User or group name.
- Description—Optional description defined during creation. To modify the description, type a new description over the existing description and click Apply.

The following controls are available:

- Delete—Deleting local users on page 76.
- Change Password—Changing local user passwords on page 77.
- Apply—Applies changes made to the Properties panel.
- Cancel— Cancels changes made to the Properties panel.

Related Objects panel:

The Related Objects panel provides links to views for objects associated with the user. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Authorization Rules - 2 opens a view listing the two authorization rules associated with the user.

Viewing local user authorization rules

This procedure explains how to view the authorization rules associated with local users.

Procedure

1. Select All Symmetrix.
2. Select Home > Administration > Security > Local Users to open the Local Users list view.
3. Select the user and click View Details to open its details view.
4. In the Related Objects panel, click Authorization Rules to open the authorization rules view.

The following properties display:

- Name—User or group name.
- Authority—Authentication authority. Possible values are:
  - Local Directory—Directory of users and encrypted passwords stored in a CST .xml file (users only, no groups).
- **Windows OS**—Local Windows users and groups.
- **Windows AD**—Windows Active Directory users and groups that are accessed through the SMAS server's domain.
- **LDAP-SSL**—Users and groups on LDAP server that have been configured the Configure Authorization wizard.

- **Authentication Domain** — Domain name. Possible values are based on the authentication authority:

<table>
<thead>
<tr>
<th>Authority</th>
<th>Domain name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local directory</td>
<td>Unisphere server hostname</td>
</tr>
<tr>
<td>Windows OS</td>
<td></td>
</tr>
<tr>
<td>Windows AD</td>
<td>Unisphere server domain</td>
</tr>
<tr>
<td>LDAP-SSL</td>
<td>LDAP server domain</td>
</tr>
<tr>
<td>Virtualization domain</td>
<td>Virtualization domain</td>
</tr>
<tr>
<td>Any authority</td>
<td>Any</td>
</tr>
</tbody>
</table>

The following controls are available:
- **Add**—Adding authorization rules on page 73
- **Remove**—Removing authorization rules on page 74
- **Edit**—Editing authorization rules on page 74

### Viewing user sessions

This procedure explains how to view active user sessions for a storage system.

**Procedure**

1. Select **All Symmetrix**.
2. Select **Home > Administration > Security > User Sessions** to open the **User Sessions** page.

   The following properties display:

   - **User Name**—Name of the individual or group.
   - **Start Time**—Date and time that the user logged in to the console.
   - **IP Address**—Address of the console.

### Roles and associated permissions

The following table details the permissions that go along with each role in Unisphere for VMAX.

<table>
<thead>
<tr>
<th>Role</th>
<th>Permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>Full access</td>
</tr>
<tr>
<td>SecurityAdmin</td>
<td>Full access</td>
</tr>
<tr>
<td>User</td>
<td>Read-only</td>
</tr>
</tbody>
</table>

**Note**

The Unisphere for VMAX Initial Setup User has all permissions on a storage system until an Administrator or SecurityAdmin is added to the storage system.
### Table 2 User roles and associated permissions

<table>
<thead>
<tr>
<th>Permissions</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Admistrator</td>
</tr>
<tr>
<td>Create/ delete user accounts</td>
<td>Yes</td>
</tr>
<tr>
<td>Reset user password</td>
<td>Yes</td>
</tr>
<tr>
<td>Create roles</td>
<td>Yes</td>
</tr>
<tr>
<td>Change own password</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage storage systems</td>
<td>Yes</td>
</tr>
<tr>
<td>Discover storage systems</td>
<td>Yes</td>
</tr>
<tr>
<td>Add/ show license keys</td>
<td>Yes</td>
</tr>
<tr>
<td>Set alerts and Optimize monitor options</td>
<td>Yes</td>
</tr>
<tr>
<td>Release storage system locks</td>
<td>Yes</td>
</tr>
<tr>
<td>Permissions</td>
<td>Roles</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Administrator</td>
</tr>
<tr>
<td>Set Access Controls</td>
<td>Yes</td>
</tr>
<tr>
<td>Set replication and reservation preferences</td>
<td>Yes</td>
</tr>
<tr>
<td>View the storage system audit log</td>
<td>Yes</td>
</tr>
<tr>
<td>Access performance data</td>
<td>Yes</td>
</tr>
<tr>
<td>Start data traces</td>
<td>Yes</td>
</tr>
<tr>
<td>Set performance thresholds/alerts</td>
<td>Yes</td>
</tr>
<tr>
<td>Create and manage performance dashboards</td>
<td>Yes</td>
</tr>
<tr>
<td>Collect and analyze database activity with Databases</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 2 User roles and associated permissions (continued)

<table>
<thead>
<tr>
<th>Permissions</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Admin</td>
</tr>
<tr>
<td>Admnistrat</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td>Analyzer</td>
<td></td>
</tr>
</tbody>
</table>

Link and launch

Creating link-and-launch client registrations

Before you begin
To perform this operation, you must be an Administrator or SecurityAdmin.
ProSphere users planning on launching Unisphere for VMAX from their respective clients, must have an Administrator or StorageAdmin role assigned to them within Unisphere for VMAX.
Link-and-launch is not supported with X.509 certificate-based user authentication.

This procedure explains how to register other applications with the SMAS server.
Once registered, users of the registered applications can launch Unisphere for VMAX without logging in.

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Link and Launch.
3. Click Create.
4. Type a unique Client ID.
   Client IDs can be up to 75 alphanumeric characters.
5. Type the Password associated with the client ID.
   Passwords can be up to 75 alphanumeric characters.
6. Retype the password to confirm it.
7. Click OK.

Editing link-and-launch client registrations

Before you begin
To perform this operation, you must be an Administrator or SecurityAdmin.
This procedure explains how to change the password associated with a registered application.
Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Link and Launch.
3. Select a registration, and click Edit.
4. Type the Current Password.
5. Type the New Password.
   Passwords can be up to 75 alphanumeric characters.
6. Retype the new password to confirm it.
7. Click OK.

Deleting link-and-launch client registrations

Before you begin
To perform this operation, you must be an Administrator or SecurityAdmin.

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Link and Launch.
3. Select a registration, and click Delete.
4. Click OK.

Viewing link and launch client registrations

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > Administration > Link and Launch.
   The Link and Launch list view allows you to view and manage link and launch client registrations.
   The following property displays:
   • Client ID—Unique client ID.
   The following controls are available:
   • Create—Creating link-and-launch client registrations on page 82
   • Edit—Editing link-and-launch client registrations on page 82
   • Delete—Deleting link-and-launch client registrations on page 83

Viewing storage system capacity reports

This procedure explains how to view capacity reports for all storage systems visible to the console:

Procedure
1. From the system selector, select All Symmetrix.
2. Select Home > VMAX Capacity to open the Symmetrix Capacity list view.
Results

The following properties display:

**Symmetrix ID**—Storage system serial ID.

**Total Physical Capacity (GB)**—Total capacity of all the disk on the storage system.

**Used Physical Capacity (GB)**—Used capacity of all the disks on the storage system.

**Total Virtual Capacity (GB)**—Total capacity of the thin pools on the storage system.

**Allocated Virtual Capacity (GB)**—Sum of the total used capacity of all the thin pools on the storage system and the total free capacity of all the thin pools on the storage system.

**# Storage Groups**—Number of storage groups on the storage system.

The following controls are available:

**Export Report**—Exporting capacity reports on page 84

**View Storage Group Capacity Report**—Viewing storage group capacity reports on page 84

---

**Viewing storage group capacity reports**

Viewing storage group capacity reports.

This procedure explains how to view capacity reports for all storage groups on a storage system:

**Procedure**

1. From the system selector, select **All Symmetrix**.
2. Select **Home > VMAX Capacity** to open the **Symmetrix Capacity** list view.
3. Select a storage system and click **View Storage Group Capacity Report**.

**Results**

The following properties display:

**Name**—Storage group name.

**Total Capacity (GB)**—Total capacity of all the volumes in the storage group.

**Allocated Capacity (GB)**—Allocated capacity of all the thin volumes in the storage group.

The following control is available:

**Export Report**—Exporting capacity reports on page 84

---

**Exporting capacity reports**

Exporting capacity reports

This procedure explains how to export capacity reports:

**Procedure**

1. From the system selector, select **All Symmetrix**.
2. Select **Home > VMAX Capacity** to open the **Symmetrix Capacity** list view.
3. Do the following, depending on whether you are exporting a storage system capacity report or a storage group capacity report:
• Storage system:
  Click Export Report.

• Storage group:
  Select a storage system and click View Storage Group Capacity Report.
  Click Export Report.
  Click OK.
  Select a location to download the report.
  Click Save.

Viewing capacity reports

All storage capacity is shown in base 2 measurement. Capacity information has more on ways of describing and measuring storage capacity.

Procedure

   
The Capacity Efficiency Report appears containing a tab for the system, and each SRP.

Notes:

• For an SRP, the Capacity panel replaces the Array Usage panel on the System tab. The panel contains the same information as the Array Usage panel for the selected SRP.

• Simplified view on page 86 defines each item on the report.

• The report in Unisphere for VMAX V8.3 on arrays running HYPERMAX OS 5977.945.890 included an item Replication Metadata. This item does not appear in the report for those arrays in Unisphere for VMAX V8.4. The value is available on the Protection Dashboard, however, as Replication Utilization. See Monitoring protection on page 446.

2. HYPERMAX OS 5977 Q2 2017 SR and later: On the System tab, you can get a more detailed breakdown of the capacity usage. Select Detailed View from the drop-down menu in the Array Usage panel.
Notes:

- For an SRP, the **Capacity** panel replaces the **Array Usage** panel on the **System** tab. The panel contains the same information as the **Array Usage** panel for the selected SRP.

- Click **Analyse Trend** next to the percentage for System Metadata or Replication Metadata to access a dashboard of charts. For more information on dashboards and how to use them, see:
  - Dashboard View
  - Using EMC summary dashboards
- **Detailed view** on page 87 defines each item on the report.

## The Capacity Report

### Simplified view

1. The total logical capacity allocated to host and eNAS usage against the total capacity subscribed to the host and eNAS.
2. The percentage of the subscribed, logical capacity that is currently allocated.
3. A graphical representation of the total logical capacity allocated to host and eNAS use as a proportion of the unallocated, logical capacity.
4. The total physical capacity used by the host and eNAS against the total, usable, physical capacity.

5. The percentage of the usable, physical capacity that is in use.

6. A graphical representation of the total physical capacity used by the host and eNAS against the total free capacity.

7. VMAX All Flash arrays only: The ratio of the sum of the TDEV and RDP logical storage (calculated on a track size of 128KB) to the amount of physical storage used for TDEVs and RDP (calculated on the track size of the compressed pool).

8. VMAX All Flash arrays only: The percentage of the allocated capacity that is enabled for compression.

9. The ratio of the configured TDEV storage to the amount of logical TDEV storage.

10. The ratio of the sum of all snapshot sizes to the amount of logical RDP storage.

11. The ratio of the sum of all TDEVs and snapshots (calculated on a track size of 128KB) to the amount of physical storage in use (calculated on the track size of the compressed pool).

For an SRP, the Capacity panel replaces the Array Usage panel on the System tab. The panel contains the same information as the Array Usage panel for the selected SRP.

Detailed view

1. The total logical capacity allocated host, eNAS, and system usage against the total subscribed capacity.

2. The percentage of the subscribed, logical capacity that is currently allocated.

3. A graphical representation of the total logical capacity used by the host, eNAS, and the system as a proportion of the total, unallocated, logical capacity.

4. The amount of physical space allocated to user (host and eNAS) activities, and the amount of physical space allocated to the system. In addition, the amount of physical space that is unallocated and available to user (host and eNAS) activities, and the amount of space that is unallocated and available for the system.

5. The amount of physical space used (for host, eNAS, and system activities) as a proportion of total usable capacity.

6. The percentage of physical capacity that is in use.

7. A graphical representation of the total physical capacity for used (for host, eNAS, system, and temporary activities) as a proportion of total free capacity.
8. The amount of physical capacity for user, system, and temporary use. In addition, the total amount of free space.

9. The amount of logical capacity that is subscribed.

10. The percentage of system metadata in use.

11. The percentage of replication metadata in use.

12. VMAX All Flash arrays only: The ratio of the sum of the TDEV and RDP logical storage (calculated on a track size of 128KB) to the amount of physical storage used for TDEVs and RDP (calculated on the track size of the compressed pool).

13. VMAX All Flash arrays only: The ratio of the TDEV logical storage (calculated on a track size of 128KB) to the amount of physical TDEV storage in use (calculated on the track size of the compressed pool).

14. VMAX All Flash arrays only: The ratio of the amount of logical RDP storage in use (calculated on a 128Kb track size) to the amount of physical RDP space in use (calculated on the track size of the compressed pool).

15. VMAX All Flash arrays only: The percentage of the allocated capacity that is enabled for compression.

16. The ratio of the configured TDEV storage to the amount of logical TDEV storage.

17. The percentage saving in TDEV configured storage presented to hosts and TDEV allocated space.

18. The ratio of storage allocated to TDEV use to the amount of logical storage allocated for TDEV use.

19. The ratio of the sum of all snapshot sizes to the amount of logical RDP storage.

20. The percentage savings of the sum of all TDEV Snapshot sizes (when the Snapshot is created) and the amount of storage allocated to TDEV Snapshots.

21. The ratio of storage allocated to Snapshot use to the logical storage for RDP use.

22. The ratio of the sum of all TDEVs and snapshots (calculated on a track size of 128KB) to the amount of physical storage in use (calculated on the track size of the compressed pool).

Notes:

- For an SRP, the Capacity panel replaces the Array Usage panel on the System tab. The panel contains the same information as the Array Usage panel for the selected SRP.

- Click Analyse Trend next to the percentage for System Metadata or Replication Metadata to access a dashboard of charts.

For more information on dashboards and how to use them, see:

- Dashboard View
- Using EMC summary dashboards
CHAPTER 4
Storage Management

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- Managing storage groups (HYPERMAX OS 5977 or later) .............................. 107
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Provisioning VMAX storage (HYPERMAX OS 5977 and higher)

With the release of HYPERMAX OS 5977 and the next generation VMAX Family systems, Unisphere for VMAX introduces support for service level provisioning. Service level provisioning simplifies storage management by automating many of the tasks associated with provisioning storage.

Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the storage performance and capacity required for the application and let the system provision the workload appropriately.

By default, storage systems running HYPERMAX OS 5977 or higher are pre-configured with a single Storage Resource Pool (SRP) containing all the physical disks on the system organized into disk groups by technology, capacity, rotational speed, and RAID protection type. Allows storage administrators to view all the SRPs configured on the system and the demand that storage groups are placing on them. For more information, refer to Managing storage groups (HYPERMAX OS 5977 or later) on page 107.

In addition, storage systems are also pre-configured with a number of Service Level and workloads, which storage administrators use to specify the performance objectives for the application they are provisioning.

When provisioning storage for an application, storage administrators assign the appropriate SRP, service level, and workload to the storage group containing the application's LUNs.

Unisphere for VMAX provides the following methods for provisioning VMAX storage:

Recommended: This method relies on wizards to step you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization (that is, the ability to create their own volumes, storage groups, and so on).

Advanced: This method, as its name implies, is for advanced users who want the ability to control every aspect of the provisioning process.
This section provides the high-level steps for each method, with links to the relevant help topics for more detail.

Regardless of the method you choose, once you have completed the process you will have a masking view, in which the volumes in the storage group are masked to the host initiators and mapped to the ports in the port group.

Before you begin:

The storage system must already be configured.

For instructions on provisioning storage systems running Enginuity 5876 or higher, refer to Provisioning VMAX storage (Enginuity 5876) on page 98.

For instructions on provisioning storage systems running Enginuity 5773 or higher, refer to Masking volumes on page 398.

To provision VMAX storage:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the Create Host dialog box to group host initiators (HBAs).</td>
<td>Use the Create Host dialog box to group host initiators (HBAs).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91</th>
<th>2. Creating volumes on page 205</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the Provision Storage wizard, which will step you through the process of creating the storage group, port group, and masking view.</td>
<td>Create one or more volumes on the VMAX system.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Creating storage groups (Enginuity 5876) on page 111</th>
<th>4. Creating port groups on page 406</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the Create Storage Group dialog box to add the volumes you just created to a storage group, and associate the storage group with a storage resource pool, a service level, and a workload.</td>
<td>Group Fibre Channel and/or iSCSI front-end directors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Creating masking views on page 394</th>
<th>5. Creating masking views on page 394</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate the host, storage group, and port group into a masking view.</td>
<td></td>
</tr>
</tbody>
</table>

Using the Provision Storage wizard (HYPERMAX OS 5977 or higher)

Before you begin

- The user must have Administrator or StorageAdmin permission.
- There are multiple ways to open the Provision Storage wizard. Depending on the method you use, some of steps listed below may not apply. For example, if you open the wizard from the Hosts view, the step on selecting a host does not apply. Or, if you open the wizard from the Reference Workload view, the steps on selecting the Service Level and Workload Type does not apply.

This procedure explains how to use the Provision Storage wizard to provision storage systems running HYPERMAX OS 5977. In addition, you can also use a subset of the steps to simply create a storage group, without actually provisioning it.

The maximum number of storage groups allowed on a storage system running HYPERMAX OS 5977 is 16,384.
For HYPERMAX OS 5977 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 64.

For instructions on provisioning storage systems running Enginuity 5876, refer to Using the Provision Storage wizard (Enginuity 5876) on page 100.

To use the Provisioning Storage wizard:

Procedure

1. Select the storage system.
2. Open the Provision Storage to Host wizard by doing either of the following:
   - Hover the cursor over the Storage menu and select Provision Storage to Host under Common Tasks to open the Provision Storage wizard.
   - On the Storage Group Dashboard (Storage > Storage Group Dashboard), open one of the storage group list views (Total, Stable, Marginal, Critical, or No SL), and click Create SG in the corresponding view.
3. Type a Storage Group Name name.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.
4. If required, select an Emulation type.
5. Select a Storage Resource Pool. To create the storage group outside of FAST control, select None. External storage resource pools are listed below the External heading.
6. Select the Service Level to set on the storage group. Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized</td>
<td>Optimized</td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

7. Select the Workload Type to assign it.
   Workload types are used to refine the service level (that is, narrow the latency range). Possible values are OLTP or DSS, where OLTP workload is focused on optimizing performance for small block I/O and DSS workload is focused on optimizing performance for large block I/O. The Workload Type can also specify whether to account for any overhead associated with replication.
(OLTP_Rep and DSS_Rep). To provision the storage group using a previously created Reference Workload, select the Reference Workload, in which case, the Service Level updates to reflect parameter defined in the Reference Workload.

8. Type the number of **Volumes** and select the **Capacity** of each.

**Note**

The maximum volume size supported on a VMAX3 system is 64 TB. It is possible to create an empty Storage Group with no volumes.

9. Optional: Hover the cursor on the service level and click edit to set any of the following options:

- To name the volumes you are adding to the storage group, select one of the following **Volume Identifiers** and type a **Name**:

  **Note**

  When using this option, Unisphere for VMAX only uses new volumes when creating the storage group; it does not use any existing volumes in the group.

  - **None**—Allows the system to name the volumes (Default).
  - **Name Only**—All volumes have the same name.
  - **Name and VolumeID**—All volumes have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
  - **Name and Append Number**—All volumes have the same name with a unique decimal suffix appended to them. The suffix starts with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

- To **Allocate capacity for each volume** you are adding to the storage group, select the option. You can only use this option for newly created volumes, not existing volumes.

  If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

10. Optional: To add a child storage group, do one of the following:

- On all-flash storage systems, click **Add Storage Group**.
- On all other storage systems click **Add Service Level**.
- Specify a storage group Name, Service Level, Workload Type, Volumes and Capacity. Repeat this step for each additional child storage group. The maximum number of allowed child storage groups is 64.

11. Optional: To set host I/O limits for the storage groups, click **Set Host I/O Limits** to open the Host I/O Limits dialog box. For instructions setting the limits, refer to the help page for the dialog box. When done, close the dialog box to return to the wizard.
12. Compression is enabled by default on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable it, uncheck the Compression check box. For more information, refer to Understanding compression.

13. To create a storage group, without actually provisioning it, click one of the following; otherwise, click Next and continue with the remaining steps in this procedure:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

14. Specify the host/host group to use by selecting an existing host/host group, or doing the following to create a new host/host group. When done, click Next.
   - To create a new host, click Create Host to open the Create Host dialog box. For instructions on creating a host, refer to the dialog's help page.
   - To create a new host group, click Create Host Group to open the Create Host Group dialog box. For instructions on creating a host, refer to the dialog's help page.

15. Select whether to use a New or an Existing port group, and then do the following depending on your selection:
   New:
   a. Optional: Edit the suggested Port Group Name by highlighting it and typing a new name over it. Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Port group names are case-insensitive.
   b. Select the ports to use. To view host-invisible ports (unmasked and unmapped), select Include ports not visible to the host. If a Fibre or iSCSI host was not selected, select the appropriate filter to filter the port list by iSCSI virtual ports or FC ports based on the selected host. If an empty host was selected, the radio button Fibre is selected by default. The Dir-Port table is filtered to only show either FC or iSCSI depending on the radio button selection.
   The following properties display:
      - Dir-Port — Storage system director and port in the port group.
      - Identifier — Port identifier.
      - Initiators Logged In — Number of initiators logged into the fabric.
      - PGs — Number of port groups where the port is a member.
      - Mappings — Number of mappings.
      - % Busy — Percentage of time that the port is busy.
   c. Click Next.

Existing: Select the port group and click Next.

16. Optional: Edit the suggested name for the Masking View by highlighting it and typing a new name over it. Verify the rest of your selections. To change any of
them, click Back. Note that some changes may require you to make additional changes to your configuration.

17. Optional: To receive alerts when the performance of the storage group changes, relative to its service level target, select Enable SL Compliance Alerts. For more information on Compliance Alerts, refer to Creating service level compliance alerts policies on page 63.

18. Optional: Determine if the storage system can handle the updated service level:
   - Click Run Suitability Check. The Suitability Check dialog box opens, indicating the suitability of the change. For information on interpreting the results, refer to the dialog’s help page. This option is only available under certain circumstances. For more information, refer to Suitability Check on page 104.
   - Click OK to close the message.
   - If your updates are found to be unsuitable, modify the settings and run the check again until the suitability check passes.

19. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Provisioning VMAX storage for mainframe (HYPERMAX OS 5977 and higher)

With the release of HYPERMAX OS 5977 Q1 2016, Unisphere for VMAX introduces support for service level provisioning for mainframe. Service level provisioning simplifies VMAX management by automating many of the tasks associated with provisioning storage.

Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the service level and capacity required for the application and the system provisions the storage group appropriately.

You can provision CKD storage to a mainframe host using the Provision Storage wizard. For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 96.

The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To provision storage for Open Systems, refer to Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91.

Mapping CKD devices to CU images
You can map CKD devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x000 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map CKD devices to CU images, see the following tasks:
   - z/OS map from the CU image list view (HYPERMAX OS 5977 or higher) on page 421
Using the Provision Storage wizard for mainframe

Before you begin

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

To provision storage to mainframe:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. In the Common Tasks panel, click **Provision Storage to Mainframe**. The Provision Storage wizard for mainframe is displayed.
4. In the **Create Storage Group** page, type a **Storage Group Name**.
   
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.
   
   If you want to create an empty storage group, proceed to the final step after typing the storage group name.
5. Select a **Storage Resource Pool**.
   
   To create the storage group outside of FAST control, select **None**. External storage resource pools are listed below the **External** heading.
6. Select an **Emulation** type. Available values are CKD-3390 and CKD-3380.
7. Select the **Service Level** to set on the storage group.

   Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None.

   Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance level</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

   For all-flash storage systems, the only service level available is Diamond and it is selected by default.
8. Type the number of **Volumes** and select either a **Model** or **Volume Capacity**.

   Selecting a **Model** type automatically updates the **Volume Capacity** value. Alternatively, you can type the **Volume Capacity**.
Note
The maximum volume size supported on a VMAX3 system is 64 TB. It is possible to create an empty Storage Group with no volumes.

9. (Optional) Configure volume options:

   Note
   When using this option, Unisphere for VMAX uses only new volumes when creating the storage group; it will not use any existing volumes in the group.

   a. Hover the cursor on the service level and click the edit icon.
   b. Edit the Volume Identifier.

      The following options are available:
      None
      Do not set a volume identifier.
      Name Only
      All volumes will have the same name. Type the name in the Name field.
      Name and VolumeID
      All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.
      Name and Append Number
      All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

   c. To Allocate capacity for each volume you are adding to the storage group, select this option. You can use this option only for newly created volumes, not existing volumes.
   d. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
   e. Click OK.

10. (Optional) To add a child storage group, do one of the following:
   - On all-flash storage systems, click Add Storage Group.
   - On all other storage systems click Add Service Level.

Specify a Name, Service Level, Volumes, and Model/Volume Capacity. Repeat this step for each additional child storage group. The maximum number of child storage groups allowed is 64.
11. To create a storage group, without actually provisioning it, click one of the following; otherwise, click **Next** and continue with the remaining steps in this procedure:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

12. On the **CU Image** page, select whether to use a **New** or an **Existing** CU image, and then do the following depending on your selection:

- **New**:
  a. Specify the following information for the new CU image:
     - **CU Image Number**
     - **SSID**
     - **Base Address**
  b. Select a **Split** with which to associate the CU image.
- **Existing**:
  a. Select a CU image.
  b. To specify a new value for the base address, click **Set Base Address**. For more information about setting the base address, refer to Setting the base address on page 427.

13. Click **Next**.

14. On the **Review** page, review the summary information displayed.

If the storage system is registered for performance, you can subscribe for compliance alerts for the storage group and run a suitability check to ensure that the load being created is appropriate for the storage system.

To enable compliance alerts, select **Enable Compliance Alerts**.

To run a suitability check, click **Run Suitability Check**.

15. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

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**Provisioning VMAX storage (Enginuity 5876)**

Provisioning storage refers to the process by which you make storage available to hosts.

Unisphere for VMAX provides the following methods for provisioning VMAX storage:

- **Recommended**: This method relies on wizards to step you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization (that is, the ability to create their own volumes, storage groups, etc.).
- **Advanced**: This method, as its name implies, is for advanced users who want the ability to control every aspect of the provisioning process.

This section provides the high-level steps for each method, with links to the relevant help topics for more detail.
Regardless of the method you choose, once you have completed the process you will have a masking view, in which the volumes in the storage group are masked to the host initiators and mapped to the ports in the port group.

Before you begin:

The VMAX system must already be configured.

For instructions on provisioning DMX storage systems, refer to Masking volumes on page 398.

To provision VMAX storage:

1. Use the Create Host dialog box to group host initiators (HBAs).
2. Use the Provision Storage wizard, which will step you through the process of creating the storage group, port group, and masking view, and to optionally associate the storage group with a FAST policy.
3. Creating storage groups (Enginuity 5876) on page 111
   Use the Create Storage Group wizard to create a storage group. If you want to add the volumes you created in step 2, be sure to set the wizard’s Storage Group Type to Empty, and then complete Adding volumes to storage groups on page 111.
4. Creating port groups on page 406
   Group Fibre Channel and/or iSCSI front-end directors.
5. Creating masking views on page 394
   Associate the host, storage group, and port group into a masking view.
6. Associate the storage group with a FAST policy
   Optional: Associate the storage you created in step 3 with an existing FAST policy.
Using the Provision Storage wizard (Enginuity 5876)

Before you begin
The storage system must already be configured and you must already have a host. For instructions on creating a host, refer to Creating hosts on page 378.

For instructions on provisioning storage systems running Enginuity 5773 or higher, refer to Masking volumes on page 398.

Note the following recommendations:
- Port groups should contain four or more ports.
- Each port in a port group should be on a different director.

There are multiple ways to open the Provisioning Storage wizard. Depending on the method you use, some of the following steps may not apply. For example, selecting a storage group in the Storage Groups list view and clicking Provision Storage to Host will open the wizard on the Select Host/Host Group page because you are starting out with a storage group.

This procedure explains how use the Provision Storage wizard to provision storage systems running Enginuity 5876. The wizard steps you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization (that is, the ability to create their own volumes, storage groups, etc.). In addition, you can also use a subset of the steps to simply create a storage group, without actually provisioning it.

The maximum number of storage groups allowed on a storage system running Enginuity 5876 is 8,192.

For Enginuity 5876 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 32.

For users who want the ability to control every aspect of the provisioning process, refer to the Advanced procedure in Using the Provision Storage wizard (Enginuity 5876) on page 100.

For instructions on provisioning storage systems running HYPERMAX OS 5977, refer to Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91.

To use the Provisioning Storage wizard:

Procedure
1. Select the storage system.
2. Hover the cursor over the Storage menu and select Provision Storage to Host under Common Tasks to open the Provision Storage wizard.
3. Type a Storage Group Name.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.
4. Select the Storage Group Type.
5. Do the following, depending on the storage group type:
   - Standard Storage Group:
     - Select the **Volume Type** to add to the storage group and click **Next**.
     - Do the following, depending on the volume type:
       - Virtual Volumes:
         a. Select the **Emulation** type for the volumes to add to the storage group.
         b. Optional: Select the **Thin Pool** containing the volumes to add to the storage group.
         c. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Size**.
         d. Optional: Hover the cursor over the volumes and click edit (↵) to set any number of the following options. Once done, click OK and continue with the remaining steps in this procedure.
           - To name the volumes you are adding to the storage group, select one of the following **Volume Identifiers** and type a **Name**:

---

**Note**

This option is only available when creating storage groups with new volumes. Note that when creating storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

---

- **None**—Allows the system to name the volumes (Default).
- **Name Only**—All volumes will have the same name.
- **Name and VolumeID**—All volumes will have the same name with a unique storage volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name and Append Number**—All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.
- To set an SSID for the volumes, type a value or click **Select** to open a dialog box from which you can select an SSID.
- To only use BCVs in the storage group, select **Use BCV volumes**.
- To **Allocate capacity for each volume** you are adding to the storage group, select the option.
   - If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
– Regular Volumes:
  a. Select the **Disk Technology** on which the storage group will reside.
  b. Select the **Emulation** type for the volumes to add to the storage group.
  c. Select the **Protection** level for the volumes to add to the storage group.
  d. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Size**.
  e. Optional: Click **Show Advanced** and set any number of the following options:
      – To only use BCVs in the storage group, select **Use BCV volumes**.
      – To only use volumes from a specific disk group, select the Disk Group.
      – To name the volumes you are adding to the storage group, select one of the following Volume Identifiers and type a Name:

**Note**

This option is only available when creating storage groups with new volumes. Note that when creating storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

  – **None**—Allows the system to name the volumes (Default).
  – **Name Only**—All volumes will have the same name.
  – **Name + VolumeID**—All volumes will have the same name with a unique storage volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
  – **Name + Append Number**—All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

  – **Template**:
    a. Select the name of the template.
    b. Type the **Number of Volumes** to add to the storage group.
    c. Optional: To name the volumes you are adding to the storage group, click **Show Advanced** and select one of the following Volume Identifiers and type a Name:
Note

This option is only available when creating storage groups with new volumes. Note that when creating storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

- **Name Only**—All volumes will have the same name.
- **Name + VolumeID**—All volumes will have the same name with a unique storage volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number**—All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

- Cascaded Storage Group:
  a. Click **Next**.
  b. Select one or more child storage groups.

- Empty Storage Group:
  Note: It is possible to create an empty Storage Group with no volumes.
  Do one of the following:
  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

6. If you want to create a storage group, without actually provisioning it, click one of the following; otherwise, click **Next** and continue with the remaining steps in this procedure:
  Do one of the following:
  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

7. Specify the host/host group to use by selecting an existing host/host group, or doing the following to create a new host/host group.
  - To create a new host, click **Create Host** to open the Create Host dialog box. For instructions on creating a host, refer to the dialog's help page.
  - To create a new host group, click **Create Host Group** to open the Create Host Group dialog box. For instructions on creating a host, refer to the dialog's help page.

8. Click **Next**.

9. Select whether to use a New or an Existing port group, and then do the following depending on your selection. When done, click **Next**.
New:

a. Optional: Edit the suggested port group Name by highlighting it and typing a new name over it. Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Port group names are case-insensitive.

b. Select the ports to use. To view host-invisible ports (unmasked and unmapped), select Include ports not visible to the host.

The following properties display:

- **Dir-Port**—Storage system director and port in the port group.
- **Initiators Logged In**—Number of initiators logged into the fabric.
- **# Port Groups**—Number of port groups where the port is a member.
- **# Mappings**—Number of volumes mapped to the port.

c. Click **Next**.

Existing: Select the port group and click **Next**.

10. Optional: Edit the suggested name for the Masking View by highlighting it and typing a new name over it. Verify the rest of your selections. To change any of them, click **Back**. Note that some changes may require you to make additional changes to your configuration.

11. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Suitability Check restrictions

The Suitability Check option is only available when:

- The storage system is registered with the performance data processing option for statistics.
- The workloads have been processed.
- The SG has only gatekeeper volumes.
- All the SGs involved have a service level and SRP set.
- The target SRP does not contain only external disk groups (like XtreamIO).
- The storage system is local.
- The SG is not in a making view (only for the local provisioning wizard). The SG should be in a masking view for the Modify SG case.

### Suitability Check

This message indicates whether the storage system can handle the updated service level. Results are indicated with either of the following:

- 🟢 Indicates suitable.
- 🟥 Indicates non-suitable.

In both cases, results are displayed in a bar chart by component (Front End, Back End, Cache) along with a score from 0 to 100 (viewed by hovering the cursor over the
bar) indicating the components expected availability on the target storage system after the change.

The current score for the component is shown in gray, with the additional load for the component shown in green or red indicating suitability. The additional score is red if the current and additional loads total more than 100.

**Viewing Reference Workloads**

**Before you begin**

This feature requires HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select Storage > Service Levels to open the Service Levels view.
3. Click the Workload Types tab.

The following properties display:

- **Reference Workloads** — Workloads configured on the system, including:
  - **Standard** — Pre-configured workloads.
  - **Custom** — User-configured workloads.

- **Details** — Displays the following details for the selected workload:
  - **Service Level** — Service level set for the workload. Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. Possible values are:
    
    | Service level | Performance type | Use case |
    |---------------|------------------|----------|
    | Diamond       | Ultra high       | HPC, latency sensitive |
    | Platinum      | Very high        | Mission critical, high rate OLTP |
    | Gold          | High             | Very heavy I/O, database logs, data backups |
    | Silver        | Price/Performance | Database datasets, virtual applications |
    | Bronze        | Cost optimized   | Backup, archive, file |
    | Optimized (Default) |           | Places the most active data on the highest performing storage and the least active on the most cost-effective storage. |

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

- **Workload** — Workload type set for the workload. Workload types are used to refine the service level (that is, narrow the latency range) Possible values are OLTP or DSS, where OLTP workload is focused on optimizing performance for small block I/O and DSS workload is focused on optimizing performance for large block I/O. The Workload Type can also specify whether to account for any overhead associated with replication (OLTP_Rep and DSS_Rep, where denotes replication).

- **I/O Density** — How efficiently FAST is managing I/O for the workload.

- **Skew** — Calculated skew density score for the disks in the storage group as a percentage of the storage group's expected values.
Creating Reference Workloads

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- This feature is only available for a user with Admin or StorageAdmin permissions.
- Creating a reference workload requires one week of data.

Reference Workloads are a reusable set of workload parameters that simplify provisioning by eliminating the ambiguity associated with matching a new workload with the appropriate pre-defined workload. Using this feature, Storage administrators create Reference Workloads from known pre-configured workloads, and then associate them with new workloads during the provisioning process.

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard, and in the Compliance panel, click Total.
3. Select the storage group containing the workload that you want to reference and click View details to open its details view.
4. If not already displaying, click the Compliance tab.
5. Click Save as Reference Workload to open the Create Reference Workload dialog box.
6. Type a Reference Workload Name.
   Reference Workload names must be unique and cannot exceed 64 characters.
7. Click OK.

Renaming Reference Workloads

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- This feature is only available for a user with Admin or StorageAdmin permissions.

Procedure

1. Select the storage system.
2. Select Storage > Service Levels to open the Service Levels view.
3. Click the Workload Types tab.
4. Hover the cursor over the Reference Workload and click Edit (✎).
5. Type a new name over the existing.
   Reference Workload names must be unique and cannot exceed 64 characters.
Managing storage groups (HYPERMAX OS 5977 or later)

The Storage Groups Dashboard provides you with a single place to monitor and manage storage groups.

Before you begin:

- The storage system must be running HYPERMAX OS 5977 or later.
- To refresh the information displayed in the Storage Groups Dashboard, click refresh Symmetrix in the status bar, or exit/return to the Storage Groups Dashboard.

To access the Storage Groups Dashboard:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard**.

   **Storage Groups Dashboard**

   The **Storage Groups Dashboard** is organized into the following panels:

   **Compliance panel**

   Displays how well the system's storage groups are complying with their respective service level policies, if applicable. All of the storage groups on the VMAX system are organized into the following categories:

   **Total**—All storage groups on the storage system.

   - Stable—Number of storage groups performing within the service level targets. indicates that there are no storage groups performing within the service level targets.

   - Marginal—Number of storage groups performing below service level targets. indicates that there are no storage groups performing below service level targets.

   - Critical—Number of storage groups performing well below service level targets. indicates that there are no storage group performing well below service level targets.

   - No SL—No service level compliance information.

   **Storage Group Management panel**

   Displays the following links:

   - **Provision Storage to Host**—Opens the Provision Storage to Host wizard, which will guide you through the process of provision storage to a host.

   - **Data Exclusion Windows**—Opens the **Data Exclusion Windows** page, This page allows you to manage Data Exclusion Windows for calculating headroom and suitability.
In addition, this panel also includes a **Search** widget, which allows you to quickly locate a specific storage group on the storage system. Double-clicking the resulting storage group will open its **Details** view.

**Storage Resource Pools panel**

Displays performance information for the Storage Resource Pools (SRPs) on the storage system. By default, VMAX systems only include a single SRP, the DEFAULT_SRP. In the event that there are multiple SRPs, each will have their own tab in the display. CKD-only SRPs are displayed in a separate tab.

For mixed FBA/CKD SRPs, a drop-down menu enables you to filter the displayed data. Available options are: All, FBA, and CKD.

The following information displays for each pool:

- Alert summary icon that displays the status and number of alerts for the SRP. Alert status is indicated by icon color:
  - One or more fatal alerts
  - One or more critical alerts, with none higher
  - One or more warning alerts, with none higher
  - One or more informational alerts, with none higher
  - No alerts

To view details on the alerts, click the icon to open the SRP Alert list view.

- **Capacity** — Displays used (allocated) verses free capacity for the SRP, with the option to overlay the amount of subscribed capacity (**Display subscription**). You also have the option to view only **SRDF DSE allocated** capacity for the SRP or **Snapshot allocated** capacity for the SRP.

- **Overall Efficiency** — Displays the VP Ratio, the Snapshot Ratio and the Compression Ratio. Click on the **Overall Efficiency** heading to open the Efficiency Report.

- **Headroom** — Displays the space available for a particular service level/workload combination if all remaining capacity was on that type. For external SRPs, headroom information is not displayed.

- **Demand Report** — Displays the allocated and subscribed capacity for the SRP by service level:
  - **Service Level** — Name of the Service Level.
  - **Allocated (GB)** — Total space the service level has allocated to it on the SRP in GB.
  - **Subscription (GB)** — Total space the service level has subscribed on the SRP in GB.
  - **Subscription (%)** — Percentage of space the service level has subscribed on the SRP.

- **Reports** — Displays links to the following reports:
  - **Storage Group Demand Report** — Displays all the storage groups on the SRP and their associated demand. For more information, refer to Viewing Storage Group Demand Reports on page 171.
Creating storage groups (HYPERMAX OS 5977 or later)

This procedure explains how to create storage groups on storage systems running HYPERMAX OS 5977 or later. In addition to method described below, you can also create a storage group using the Provision Storage wizard, as described in Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91.

For instructions on creating storage groups on storage systems running Enginuity 5876, refer to Creating storage groups (Enginuity 5876) on page 111.

Before you begin:

- The user must have Administrator or StorageAdmin permission.
- The maximum number of storage groups allowed on a storage system running HYPERMAX OS 5977 is 16,384.
- For HYPERMAX OS 5977 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 64.
- A storage group can contain up to 4,096 volumes.
- A volume can belong to multiple storage groups if only one of the groups is under FAST control.
- You cannot create a storage group containing CKD volumes and FBA volumes.

To create a storage group:

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Select one or more volumes and click **Create SG**.
4. Type a **Storage Group Name**.
   
   Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.

5. To create the storage group outside of FAST control, set **Storage Resource Pool** to None; otherwise, leave this field set to the default.

6. Select the Service Level to set on the SG.
Service level policies specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

7. Refine the service level by selecting the **Workload Type** to assign it.

   Possible values for the **Workload Type** are:
   - OLTP
   - OLTP_REP
   - DSS
   - DSS_REP

   The workload type does not apply when the service level is Optimized or None.

8. Click **OK** to create the storage group now, or click **Advanced** to continue setting the advanced options, as described in the remaining steps.

9. Compression is enabled by default on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable the feature, uncheck the **Compression** check box. For more information, refer to **Understanding compression**.

10. Optional: Select **Allocate Full Volume capacity**.

11. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**.

   Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

12. Click **OK**.
Creating storage groups (Enginuity 5876)

This procedure explains how to create storage groups on VMAX systems running Enginuity 5876. For instructions on creating storage groups on VMAX systems running HYPERMAX OS 5977, refer to Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91.

Before you begin:

- You must have Administrator or StorageAdmin permission.
- The maximum number of storage groups allowed on a VMAX system is 8,192.
- For Enginuity 5876 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 32.
- A storage group can contain up to 4,096 storage system volumes.
- A storage system volume can belong to more than one storage group.
- In this procedure you can optionally name the volumes you are adding the storage group. For more information, refer to Setting volume names on page 226.
- This procedure explains how to create storage groups using the Provision Storage wizard, which involves only the first page of the wizard. For instructions on completing the wizard, thereby provisioning the new storage groups, refer to Using the Provision Storage wizard (Enginuity 5876) on page 100.
- Empty SGs are not displayed while creating a cascaded SG.

To create a storage group:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Click Create SG.
4. Refer to Using the Provision Storage wizard (Enginuity 5876) on page 100, for information about the Provision Storage wizard.

Adding volumes to storage groups

This procedure explains how to add volumes to existing storage groups.

Before you begin:

Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.

To add volumes to storage groups:

Procedure

1. Select the storage system.
2. Do the following, depending on the storage operating environment:
   - For HYPERMAX OS 5977 or higher:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the COMPLIANCE panel, click Total to open the Storage Groups list view.
   - For HYPERMAX OS 5977 or higher with a mainframe environment:
a. Select **Hosts** > **Mainframe Dashboard** to open the **Storage Groups Dashboard**.

b. In the **COMPLIANCE** panel, click **Total** to open the **Storage Groups** list view.

- For Enginuity 5876:
  Select **Storage** > **Storage Groups** to open the **Storage Group** list view.

3. Select the storage group and click **View Details**.

4. In the **Related Objects** panel, click **Volumes**.

5. Click **Add Volumes to SG** to open the **Add Volumes to Storage Group** wizard.

6. Locate the volumes by selecting or typing values for any number of the following criteria:

- **Capacity equal to**—Filters the list for volumes with a specific capacity.
- **Volume ID**—Filters the list for a volume with specific ID.
- **Volume Identifier Name**—Filters the list for the specified volume name.
- **Additional Criteria**—Allows you to refine your query by adding conditional expressions, as describe next:
  a. Select values for the following:

     - **Category**—Specifies the broad category.
     - **Attribute**—Refines the category.
     - **Operator**—Establishes the relationship between the attribute and the value.
     - **Value**—Conditions for the specified attribute.

  b. To add another expression, click **Add Another**, and repeat the previous step. To clear your criteria, click **Clear All**.

- **Include Volumes in Storage Groups**—Includes volumes already in other storage groups.

7. Click **Find Volumes** to run the query.

   Results are displayed on the next page in the wizard.

8. Do one of the following:

   - Select the **Volumes** and click **Add to SG**.
   - Click **Modify Criteria** to modify your search query.

### Copying volumes between storage groups

This procedure explains how to copy volumes between storage groups.

To copy volumes between storage groups:

**Procedure**

1. Select the storage system.

2. Do the following depending on the storage operating environment:

   - For HYPERMAX OS 5977 or later:
     a. Select **Storage** > **Storage Groups Dashboard** to open the **Storage Groups Dashboard**.

     b. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
Moving volumes between storage groups

This procedure explains how to move volumes between storage groups.

Before you begin:

- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.
- The user must have StorageAdmin permission.
- To perform this operation without disrupting the host’s ability to view the volumes, at least one of the following conditions must be met:
  - Each storage group must be a child of the same parent storage group, and the parent storage group must be associated with a masking view.
  - Each storage group must be associated with a masking view, and both masking views must contain a common initiator group and a common port group. In this scenario, the port groups can be different, but they must both contain the same set of ports, or the target port group can contain a superset of the ports in the source port group.
  - The source storage group is not in a masking view.

To move volumes between storage groups:

**Procedure**

1. Select the storage system.
2. Do the following depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
     b. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
   - For Enginuity 5876:
     Select **Storage > Storage Groups** to open the **Storage Group** list view.
3. Select the storage group and click **View Details**.
4. In the **Related Objects** panel, click **Volumes**.
5. Select one or more volumes, click **>>,** and click **Move Volumes to SG** to open the **Move Volumes to Storage Group** dialog box.
6. Select the **Target Storage Group Name**.
7. Optional: By default, the operation will fail if at least one of the conditions above is not met. To override this default behavior, select **Use force flag**.
Removing volumes from storage groups

This procedure explains how to remove volumes from storage groups.

Before you begin:
Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or higher.

To remove volumes from storage groups:

Procedure

1. Select the storage system.
2. Do the following depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.
3. Select the storage group and click View Details.
4. In the Related Objects panel, click Volumes.
5. Select one or more volumes and click Remove Volumes to open the Remove Volume dialog box.
6. To unbind the volumes, select Unbind or Unmap, depending on the storage operating environment.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Expanding storage groups (Enginuity 5876)

This procedure explains how to increase the amount of storage in a group accessible to the masking view or in the FAST Policy.

Before you begin:
- This procedure requires Enginuity 5876.
- In this procedure you can optionally name the volumes you are adding the storage group. For more information, refer to Setting volume names on page 226.
- Empty SGs are not displayed while creating a cascaded SG.

To expand a storage group:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select the storage group and click Expand to open the Expand Storage Group wizard.
4. Select a method for expanding the storage group. Possible values are:
   - **Virtual Volumes**—Expands the group using virtual volumes.
   - **Regular Volumes**—Expands the group using regular volumes. This option is not available for Symmetrix VMAX 10K/VMAXe systems.
   - **Template**—Expands the group using a storage template.
   - **Copy Volume Configuration**—Expands the group by copying the configuration of volumes already in the group.

5. Click **Next**.

6. Do the following, depending on the method you are using:

   **Virtual Volumes:**
   a. Select the **Emulation** type for the volumes to add to the storage group.
   b. Select the **Thin Pool** to which the volumes will be added.
   c. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Size**.
   d. Click **Show Advanced** and set any of the following options:
      - To only use BCVs in the storage group, select **Use BCV volumes**.
      - Specify to **Allocate Full Volume capacity**.
      - If you selected to allocate full volume capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
      - To name the volumes you are adding to the storage group, select one of the following **Volume Identifiers** and type a **Name**:
         - **None**—Allows the system to name the volumes (Default).
         - **Name Only**—All volumes will have the same name.
         - **Name + VolumeID**—All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
         - **Name + Append Number**—All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.
         - To set an SSID for the volumes, type a value or click **Select** to open a dialog box from which you can select an SSID.
   e. Click **Next**.

   **Regular Volumes:**
a. Select the **Disk Technology** type for the volumes to add to the storage group.

b. Select the **Emulation** type for the volumes to add to the storage group.

c. Select the **Protection** level for the volumes to add to the storage group.

d. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Size**.

e. Click **Show Advanced** and set any of the following options:

- To only use BCVs in the storage group, select **Use BCV volumes**.
- To only use volumes from a specific disk group, select the **Disk Group**.
- To name the volumes you are adding to the storage group, select one of the following **Volume Identifiers** and type a **Name**:

  **Note**
  
  This option is only available when expanding storage groups with new volumes. Note that when expanding storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

f. Click **Next**.

Template:

a. Select the **Template** and click **Next**.

b. Type the **Number of Volumes** to add to the storage group.

c. Select the **Thin Pool** containing the volumes to add to the storage group.

d. Click **Show Advanced** and set any of the following options:

- **z/OS Only**: If the storage group contains CKD volumes, type an **SSID** for the target, or click **Select ...** to open a dialog from which you can select an SSID.

- To name the volumes you are adding to the storage group, click **Show Advanced** and select one of the following **Volume Identifiers** and type a **Name**:
Note

This option is only available when expanding storage groups with new volumes. Note that when expanding storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

e. Click **Next**.

**Copy Volume Configuration:**

a. Select a volume to copy.

b. Type the **Number of Volumes** to add.

c. To name the volumes you are adding to the storage group, click **Show Advanced** and select one of the following **Volume Identifiers** and type a **Name**:

Note

This option is only available when creating storage groups with new volumes. Note that when creating storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

d. Click **Next**.

7. Verify your selections in the **Summary** page. To change any of your selections, click **Back**.

Note that some changes may require you to make additional changes to your configuration.
8. Click Finish.

Modifying storage groups

This procedure explains how to modify storage groups on storage systems running HYPERMAX OS 5977 or later.

This procedure explains how to perform the operation from the Storage Groups Dashboard.

- In eNAS operating environments, you can perform this operation from Storage Groups for File page (System > System Dashboard > File Dashboard > File Storage Groups).
- In Mainframe environments, you can perform this operation from the Storage Groups page (Hosts > Mainframe Dashboard > Storage Groups).

Before you begin:

- You must be an Administrator or StorageAdmin.
- The maximum number of storage groups allowed on a storage system is 16,384.
- A storage group can contain up to 4,096 storage volumes.
- A volume can belong to more than one storage group.
- A volume can belong to multiple storage groups if only one of the groups is under FAST control.

To modify a storage group:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.
3. Select the storage group and click Modify to open the Modify Storage Group dialog box.
4. Do any number of the following:
   a. Change the Storage Group Name by highlighting it and typing a new name over it. Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and dashes (-) are allowed. Storage group names are case-insensitive. Note the following about renaming storage groups:
      - If renaming a storage group with workload on it, you will have to wait some time before the workload is visible in the storage group's Details view.
      - When renaming a storage group configured compliance alerts, the compliance alerts will need to be deleted manually. For instructions, refer to Deleting compliance alerts policies on page 65.
   b. Change the Storage Resource Pool by selecting the new pool from the drop-down menu. Setting this property to None creates the storage group outside of FAST control. External storage resource pools are listed below the External heading.
   c. Change the Service Level for the storage group. Service levels specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Possible values are:
<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

d. Change the **Workload Type** assigned to the service level.

e. Add or remove **Volumes**.

f. Do the following to change the capacity of the storage group, depending on whether the group contains volumes of the same capacity or mixed capacities:

- If the group contains volumes of the same capacity, do one of the following:
  - Type or select an increased number of volumes in the **Volumes** drop-down menu.
  - Type or select an increased unit capacity of the volumes and/or change the unit in the **Volume Capacity** drop-down menus.

  **Note**
  In mixed FBA/CKD All Flash systems, volume capacity defaults to **GB** for FBA Storage Groups and **Cyl** for CKD Storage Groups.

- If the group contains volumes of mixed capacities, click **Edit custom capacity** to open the **Modify Custom Capacity** dialog box. Change the number of **Volumes** by capacity, and click **OK**. You can only use the **Allocate capacity for each volume** option for newly created volumes, not existing volumes.

  The **Total Capacity** and **Additional Capacity** figures are updated to reflect any changes.

  **Note**
  The maximum volume size supported on a VMAX3 system is 64 TB. VMAX All Flash systems running the HYPERMAX OS 5977 Q2 2017 Service Release or higher supports a maximum CKD device size of up to 1,182,006 cylinders.

g. Optional: to add a child storage group, do one of the following:

- On all-flash storage systems, click **Add Storage Group**.
- On all other storage systems, click **Add Service Level**.
Modify any of the service level parameters, as described earlier in this procedure.

5. Compression is enabled by default on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable the feature, uncheck the Compression check box. In a cascaded setup, changes will be passed to each of the child storage groups. For more information on compression, refer to Understanding compression.

6. Optional: To determine if the storage system can handle the updated service level:
   a. Click Run Suitability Check. The Suitability Check dialog box opens, indicating the suitability of the change. For information on interpreting the results, refer to the dialog's help page. This option is only available under certain circumstances. For more information, refer to Suitability Check restrictions on page 104.
   b. Click OK to close the message.
   c. If your updates are found to be unsuitable, modify the settings and run the check again until the suitability check passes.

7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Modifying storage groups (5876)

This procedure explains how to modify storage groups on VMAX systems running Enginuity 5876.

Before you begin:
- You must have Administrator or StorageAdmin permission.
- The maximum number of storage groups allowed on a VMAX system is 8,192.
- A storage group can contain up to 4,096 VMAX volumes.
- A VMAX volume can belong to more than one storage group.

To modify a storage group:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select the storage group and click View Details.
4. Optional: Make changes in the Properties panel and click Apply.
5. In the Related Objects panel, click Volumes.
6. Do the following, depending on whether you are adding or removing volumes:
   Adding volumes:
   a. Click Add to open the Add Volumes to Storage Group dialog box.
   b. Select the volumes to add to the storage group.
c. If adding volumes to a storage group that is part of a masking view, click Set Dynamic LUN Addresses to open the Set LUN Address - Storage Group dialog box, in which you can manually assign the host LUN addresses for all the volumes you are adding to the group. When done, click OK to close the dialog box.

d. Click OK in the Add Volumes to Storage Group dialog box.

Removing volumes:

a. Select the volumes to remove from the storage group and click Remove to open the Remove Volume dialog box.

b. If the volumes are mapped, select to Unmap them.

c. If the volumes are thin, select to Unbind them.

d. Click one of the following:

   a. Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

   b. Expand Add to Job List, and click Run Now to perform the operation now.

Renaming storage groups

This procedure explains how to rename storage groups.

Before you begin:

- Storage group names must be unique from other storage groups on the VMAX system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Storage group names are case-insensitive.

- Storage groups require Enginuity 5876, or HYPERMAX OS 5977 or later.

To rename a storage group:

**Procedure**

1. Select the storage system.

2. Do the following depending on the storage operating environment:

   a. For HYPERMAX OS 5977 or later:
      
      a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
      
      b. In the Storage Groups panel, click Total to open the Storage Groups list view.

   b. For Enginuity 5876:
      
      Select Storage > Storage Groups to open the Storage Group list view.

3. Select the storage group and click View Details.

4. In the Properties panel, type a new name for the storage group and click Apply.

Moving storage groups to EMC CloudArray

This procedure explains how to move storage groups to EMC CloudArray.
If a child storage group is moved to CloudArray, all sibling storage groups are also moved. If a parent storage group is moved to CloudArray, the child storage groups are also moved.

**Before you begin**
- The user must have Admin or StorageAdmin permission.
- The storage system must have an EMC CloudArray SRP.

To move storage groups to CloudArray:

**Procedure**
1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** and, in the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
3. Select a storage group, click **>>**, and click **Move to EMC CloudArray**.
   Information about the storage group and the SRPs from which and to which it is being moved displays.
4. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Cloning storage groups**

**Before you begin**
- This feature requires the Enginuity 5876 Q2 SR or higher.
- The storage group must contain only thin volumes (except gatekeepers under 10 MB) and they must all be of the same type (either BCV or standard thin volumes (TDEVs). This restriction also applies to cascaded storage groups, that is, all volumes in the parent and child storage groups must be thin and of the same type.
- The SYMAP_ALLOW_DEV_INT_MULTI_GRPS option must be enabled. For instructions on enabling the option, refer to **Editing the Options file** in the **Solutions Enabler Installation Guide**.
- Meta volumes are not supported.

To clone storage groups:

**Procedure**
1. After successfully provisioning a storage group using the Provision Storage wizard, click **Clone Storage Group**.
2. Type the **Name of Device Group** to hold the target volumes.
3. Select the thin pool to which the target volumes will be bound (Bind to Pool). If the source storage group contains thin volumes bound to different thin pools, or if it is a cascaded storage group with child storage groups containing volumes bound to different thin pools, selecting a single thin pool will result in all target volumes being bound to that single pool.
4. (Optional) Clear the **Create Replica Storage Group** option in which case a storage group for the target volumes will not be created. Leaving the option
selected allows you to optionally change the name of replica storage group. Changing the name will also change the target volume storage group name.

5. z/OS Only: If the storage group contains CKD volumes, type a **New SSID** for the target, or click **Select ...** to open a dialog from which you can select an SSID.

Click one of the following:

- **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
- Click **Show Advanced** to continue setting the advanced options, as described next.

a. Select a mode in which to create the clone session **Clone Copy Mode**. The mode you specify here will override the mode specified in the system preferences. Possible values are:

   - **Copy No Diff**
     - Creates a nondifferential (full) copy session in the background.
   
   - **PreCopy No Diff**
     - Creates a nondifferential (full) copy session in the background before the activate starts.

   - **Copy Diff**
     - Creates a differential copy session in the background. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).
   
   - **PreCopy Diff**
     - Creates a differential copy session in the background before the activate starts. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).

   - **VSE No Diff**
     - Creates a VP Snap Copy session.

b. Select a method for creating the clones (**Clone Creation**). Possible values are:

   - **Best Effort**
     - Specifies to make every effort to use existing volumes as the targets, and then create new volumes as necessary.
   
   - **Find Existing**
     - Specifies to only use exiting volumes as the targets.

   c. Select the type of volumes to use as the targets (**Clone Targets**).
   d. Click one of the following:

   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information,
Protecting storage groups

The Protect Storage Group wizard guides you through the process of protecting your storage group. Depending on the capabilities of the storage system, the following options may be available:

- **Snap/VX**—For instructions, refer to Creating snapshots on page 476. This is the default method for storage systems running HYPERMAX OS 5977 or higher.
- **TimeFinder/Clone**—For instructions, refer to Protecting storage groups using TimerFinder/Clone on page 124. This is the default method for storage systems running Enginuity 5876.
- **ProtectPoint**—For instructions, refer to Protecting storage groups using ProtectPoint on page 126. This method is only available on storage systems running HYPERMAX OS 5977 or later.
- **RecoverPoint**—For instructions, refer to Protecting storage groups using RecoverPoint on page 590. This is method is only available for storage systems running Enginuity 5876.
- **SRDF**—For instructions, refer to Protecting storage groups using SRDF on page 127. This method is available for storage systems, subject to connectivity rules.
- **SRDF/Metro**—For instructions, refer to Protecting storage groups using SRDF/Metro on page 129. This is method is only available for storage systems running HYPERMAX 5977 or higher.

Protecting storage groups using TimerFinder/Clone

Before you begin:

- This feature requires the Enginuity 5876.163.105 or later. This feature does not apply to storage systems running HYPERMAX OS 5977 or later.
- The storage group must contain only thin volumes (except gatekeepers under 10 MB) and they must all be of the same type (either BCV or standard thin volumes (TDEVs). This restriction also applies to cascaded storage groups, that is, all volumes in the parent and child storage groups must be thin and of the same type.
- The SYMAP_ALLOW_DEV_INT_MULTI_GRPS option must be enabled. For instructions on enabling the option, refer to "Editing the Options file" in the Solutions Enabler Installation Guide.
- Meta volumes are not supported.

To protect storage groups using TimeFinder/Clone:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups**.
3. Select the storage group and click **Protect** to open the **Protect Storage Group** wizard.
4. If not already selected, select **Point In Time Protection Using Clone**.
5. Click **Next**.
6. Type the name of the device group that will hold the target volumes (Device Group Name).

7. Select the thin pool to which the target volumes will be bound (Bind to Pool). If the source storage group contains thin volumes bound to different thin pools, or if its a cascaded storage group with child storage groups containing volumes bound to different thin pools, selecting a single thin pool will result in all target volumes being bound to that single pool.

8. Clear the Create Replica Storage Group option in which case a storage group for the target volumes will not be created. Leaving the option selected allows you to optionally change the name of replica storage group (Storage Group Name). Changing the name will also change the target volume storage group name.

9. z/OS Only: If the storage group contains CKD volumes, type a New SSID for the target, or click Select ... to open a dialog from which you can select an SSID.

10. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced Options: Select the mode in which to create the clone session Clone Copy Mode. You can set the default clone copy mode in the Preferences dialog box, as described in . The mode you specify here will override the default mode specified in the preferences. Possible values are:

   - No Copy No Diff — Create a nondifferential (full) copy session without a full background copy.
   - Copy No Diff — Creates a nondifferential (full) copy session in the background.
   - PreCopy No Diff — Creates a nondifferential (full) copy session in the background before the activate starts.
   - Copy Diff — Creates a differential copy session in the background. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).
   - PreCopy Diff — Creates a differential copy session in the background before the activate starts. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).
   - VSE No Diff — Creates a VP Snap Copy session.

11. Select a method for creating the clones (Clone Creation).
    Possible values are:
Best Effort—Specifies to make every effort to use existing volumes as the targets, and then create new volumes as necessary.

Find Existing—Specifies to only use exiting volumes as the targets.

Create New—Specifies to create new volumes to use as targets.

12. Select the type of volumes to use as the targets (Clone Targets).

13. Click Next.

14. Verify your selections, and then do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand Add to Job List, and click Run Now to perform the operation now.

### Protecting storage groups using ProtectPoint

#### Before you begin

- The storage system must be running HYPERMAX OS 5977.
- You must have StorageAdmin permission.
- The Data Domain appliance must be connected and zoned to the storage system.
- Provide the Data Domain Admin the number and size of volumes in the production storage group and request that they provide you with double the number of similar volumes (masked/visible to the storage system). For example, if the production storage group contains 10 volumes, the Data Domain Admin should provide you with the LUN numbers of 20 similar volumes.
- CKD devices are not supported by ProtectPoint.

To protect storage groups using ProtectPoint:

#### Procedure

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the Storage Groups panel, click Total.
4. Select the storage group and click Protect to open the Protect Storage Group wizard.
5. Select Backup Using ProtectPoint.
6. Click Next.
7. Click OK.
8. Type the name of the Point In Time Copy Name and click Next.
9. Type a name for the Backup Storage Group, or leave the system-generated suggestion.
10. Select the external LUNs to add to the backup storage group and click Add to Storage Group.
    Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.
11. Click Next.
12. Type a name for the New Restore Storage Group, or leave the system-generated suggestion.
13. Select the external LUNs to add to the restore storage group and click **Add to Storage Group**.

   Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.

14. Click **Next**.

15. Verify your selections. To change any of them, click **Back**.

   Note that some changes may require you to make additional changes to your configuration.

16. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

17. Once the job completes successfully, provide the following information to the Data Domain Admin:
   - The LUN numbers used in the backup storage group
   - The LUN numbers used in the restore storage group
   - The name of the point in time copy

**Protecting storage groups using SRDF**

This procedure explains how to protect storage groups using SRDF.

**Before you begin:**
- SRDF requires Enginuity version , or HYPERMAX OS 5977 or higher.
- You must have StorageAdmin permission.
- Connectivity to remote storage system must be available.
- All storage systems involved must be discoverable and manageable from the console.
- The SRDF wizard in Unisphere for VMAX 8.1 and higher releases supports the mandatory creation of a storage group and the optional creation of a device group. The storage group may contain non-concurrent SRDF devices of any one SRDF type, or may contain non-SRDF devices.
- The following validation check is performed by the wizard to determine if selected storage group be SRDF protected: Volumes in the storage group need to be all TDEV’s, or all volumes in the storage group need to be R1s and in the same SRDF Group, or all volumes need to be R2s and in the same SRDF Group.
- The SRDF wizard in Unisphere for VMAX 8.2 and higher releases supports the creation of SRDF protection for CKD Storage Groups.
- Set the default number of ports to use with SRDF. To set this number, select **All Symmetrix > Home > Administration > Preferences**.

**To protect storage groups using SRDF:**

**Procedure**

1. Select the storage system.
2. Do the following depending on the storage operating environment:
For HYPERMAX OS 5977 or later:
   a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
   b. In the Storage Groups panel, click Total to open the Storage Groups list view.

For Enginuity 5876:
   Select Storage > Storage Groups to open the Storage Group list view.

3. Select the storage group and click Protect to open the Protect Storage Group wizard.
   The Select Protection Type page displays.

4. Select Remote Replication Using SRDF.
5. Click Next.
6. Select the Remote Symmetrix system. To update the list of remote systems, click Scan.
7. Select the Replication Mode. For more information, refer to SRDF session modes on page 556.
8. Select Auto to automatically select a SRDF group or Manual to select a SRDF group from a list.
9. Optional: To not start pair mirroring, clear the Establish Pairs option.
10. Do the following, depending on the storage operating environment (target system):
   For HYPERMAX OS 5977 or later:
       Optional: Change the Remote Storage Group Name, and optionally select a Remote Service Level. Changing the name will also change the target volume storage group name.
   For Enginuity 5876:
       a. Select the Remote Thin Pool to which the target volumes will be bound. If the source storage group contains thin volumes bound to different thin pools, or if it is a cascaded storage group with child storage groups containing volumes bound to different thin pools, selecting a single thin pool will result in all target volumes being bound to that single pool.
       b. Optional: Select the Remote FAST Policy. This is the FAST policy associated with the remote storage group.
       c. z/OS Only: If the storage group contains CKD volumes, type a New SSID for the target, or click Select ... to open a dialog from which you can select an SSID.
11. Click Create Device Group check box and select the Device Group Name that will hold the target volumes.
12. Click Next.
   The Finish page displays.
13. Verify your selections. To change any of them, click Back.
   Note that some changes may require you to make additional changes to your configuration.
14. Do one of the following:
Protecting storage groups using SRDF/Metro

This procedure explains how to protect storage groups using SRDF/Metro, in order to improve support for host applications in high availability environments.

Before you begin:

- SRDF requires HYPERMAX OS 5977 or later.
- You must have StorageAdmin permission.
- Connectivity to remote storage system must be available.
- All storage systems involved must be discoverable and manageable from the console.
- CKD devices are not supported by SRDF/Metro.

You are not allowed to set RDF devices in the non-Metro RDF mirror to operate in Synchronous mode.

To protect storage groups using SRDF Metro:

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.
3. Select the storage group and click Protect to open the Protect Storage Group wizard.
   - The Select Protection Type page displays.
4. Select High Availability using SRDF/Metro.
5. Click Next.
6. Select the Remote Symmetrix system. To update the list of remote systems, click Scan.
7. Select Auto to automatically select a SRDF group or Manual to select a SRDF group from a list.
8. Optional: To stop the initiation of pair mirroring, clear the Establish Pairs option.
9. If Establish Pairs is checked, choose Managed by Witness or Bias.
   - If Witness is unavailable on the local or remote Symmetrix, the option is disabled and Bias is selected by default. If available, Witness is selected by default.
   - For storage systems running HYPERMAX OS 5977 Q3 2016 or higher, when the Witness radiobutton is selected, the Witness Candidate (Remote Symmetrix) field displays a list of physical and Virtual witnesses instances which are enabled. Disabled virtual witness instances are not displayed.
    - Changing the name will also change the target volume storage group name.
11. Click Next. The Finish page displays.

12. Verify your selections. To change any of them, click Back.

   Note that some changes may require you to make additional changes to your configuration.

13. Do one of the following:

   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

   • Expand Add to Job List, and click Run Now to perform the operation now.

Converting storage groups to cascaded

This procedure explains how to non-disruptively convert a standalone storage group to cascaded storage group. Once complete, the original storage group will serve as the parent to a new child storage group.

This procedure explains how to perform the operation from the Storage Groups Dashboard. In eNAS operating environments, you can also perform this operation from Storage Groups for File page (System > System Dashboard > File Dashboard > File Storage Groups).

Before you begin:

• You must have Administrator or StorageAdmin permission.

• The storage system must be running HYPERMAX OS 5977 or later.

To convert storage groups:

Procedure

1. Select the storage system.

2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.

3. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.

4. In the Storage Groups panel, click Total to open the Storage Groups list view.

5. Select the storage group, click , and select Convert to Cascaded to open the Convert to Cascaded dialog box.

6. Type a new name over the system-suggested Child Storage Group Name.

   Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.

7. Click OK.

Changing Storage Resource Pools for storage groups

This procedure explains how to change the Storage Resource Pool of a parent storage group, with child service levels using different Storage Resource Pools.

This procedure explains how to perform this operation from the Storage Groups Dashboard. In eNAS environments, you can also perform this operation from the File Storage Groups page (System > System Dashboard > File Dashboard > File Storage Groups).

Before you begin:
To change the Storage Resource Pool for storage groups:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** and, in the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
3. Select the storage group, click more \( \rightarrow \rightarrow \), and select **Change SRP** to open the **Change SRP** dialog box.
4. Select the new SRP.
5. (Optional) Change the Service Level for the SG. Service levels specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

6. (Optional) Refine the service level by selecting the **Workload Type** to assign it.
7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Associating FAST policies with storage groups**

The procedure for associating FAST policies and storage groups, depends on whether you are associating a storage group with a policy or policy with a storage group.
Before you begin

Storage groups and FAST policies can only be associated under the following conditions:

- The VMAX system is running Enginuity 5876.
- The target FAST policy needs to have at least one pool that is part of the source policy in re-association activity.
- The volumes in the new storage group are not already in a storage group associated with a FAST policy.
- The policy has at least one tier.
- The storage group only contains meta heads; meta members are not allowed.
- The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:
  - CKD EAV
  - DRV
  - SFS
  - iSeries, ICOS, ICL
  - SAVE volumes
  - VDEVs
  - Diskless volumes
- The storage group cannot contain a volume that is part of another storage group already associated with another policy.
- The storage system has fewer than the maximum number of allowed associations (8,192).

To associate a FAST policy with a storage group:

Procedure

1. Select the storage system.
2. Select Storage > FAST.
3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies panel, click Manage Policies.
5. Select the policy and click Associate Storage Groups to open the Associate Storage Groups dialog box.
6. Select one or more storage groups, and then click either of the following:
   - OK to associate the storage group.
   - Show Advanced to continue setting the advanced options.
     a. To have FAST factor the R1 volume statistics into move decisions made for the R2 volume, select Enable FAST [VP|DP] RDF Coordination. This attribute can be set on a storage group, even when there are no SRDF volumes in the storage group. This feature is only available if the storage system is part of an SRDF setup. Both R1 volumes and R2 volumes need to be running Enginuity version 5876 or higher for the FAST VP system to coordinate the moves. However, the setting of the
RDF coordination attribute will not be prevented if one of the Symmetrix systems is running an Enginuity level lower than 5876.

b. Click OK.

Associating storage groups with FAST policies

Before you begin

Storage groups and FAST policies can only be associated under the following conditions:

- The VMAX system is running Enginuity 5876.
- The target FAST policy needs to have a least one pool that is part of the source policy in re-association activity.
- The volumes in the new storage group are not already in a storage group associated with a FAST policy.
- The policy has at least one tier.
- The storage group only contains meta heads; meta members are not allowed.
- The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:
  - CKD EAV
  - DRV
  - SFS
  - iSeries, ICOS, ICL
  - SAVE volumes
  - VDEVs
  - Diskless volumes
- The storage group cannot contain a volume that is part of another storage group already associated with another policy.
- The storage system has fewer than the maximum number of allowed associations (8,192).

To associate a storage group with a FAST policy:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select the storage group, click more, and select Associate to FAST to open the Associate to FAST Policy dialog box.
4. Select a policy and click OK.

Disassociating FAST policies and storage groups

Procedure

1. Select the storage system.
2. In the navigation bar, click Storage to open the Storage section.
3. Click FAST to open the FAST dashboard.
4. Select the FAST Type.
5. In the FAST Policies view block, click Manage Policies to open the FAST Policies details view.
6. Select the policy and click View Details to open the policy's details view.
7. In the Related Object view panel, click Storage Groups - nn to open the Storage Groups for FAST Policy details view.
8. Select the one or more storage groups and click Disassociate.
9. Click OK.

Reassociating FAST policies and storage groups

Before you begin
- This feature requires Enginuity 5876.
- The storage group name must be valid.
- The storage group and policy must already exist on the storage system.
- The storage group must be in an association before performing a reassociation.
- The new policy for the storage group, must have the same emulation as the storage group. Mix emulation association will result in an error.
- The storage group cannot be associated with an empty policy, and the reassociated policy must contain at least one tier.
- The total of the capacity percentage for the target FAST policy must add up to at least 100%.
- If the FAST policy contains VP Tiers, all of the thin devices in the storage group must be bound to any VP pool in a tier in the policy. None of the thin devices can be bound to a pool outside of the policy.

This procedure explains how to reassociate a storage group with a new policy. When reassociating a storage group, all the current attributes set on the original association automatically propagate to the new association. This feature eliminates the previous process of disassociating a storage group, then associating the group to a new policy, and entering the attributes, such as priority, on the association.

Procedure
1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups list view.
3. Select the storage group, click more, and click Reassociate to FAST Policy to open the Reassociate to FAST Policy dialog box.
4. Select a policy and click OK.

Adding or removing cascaded storage groups

This procedure explains how to add or remove child storage groups from parent storage groups.

Before you begin:
Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or higher.

To add or remove cascaded storage groups:
Procedure

1. Select the storage system.

2. Do the following, depending on the storage operating environment:
   - For HYPERMAX OS 5977 or higher:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.

3. Select the parent storage group and click View Details to open its Details view.

4. In the Related Object panel, click Child Storage Group to open the Child Storage Groups list view.

5. Do the following, depending on whether you are adding or removing storage groups:
   - Adding storage groups:
     a. Click Add Storage Group to open the Add Storage Group dialog box.
     b. Select one or more storage groups and click OK.
   - Removing storage groups:
     a. Select one or more storage groups and click Remove.
     b. Enginuity 5876 only: To unmap, select Unmap Device.
     c. Click OK in the confirmation message.

Renaming storage groups

This procedure explains how to rename storage groups.

Before you begin:
   - Storage group names must be unique from other storage groups on the VMAX system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.
   - Storage groups require Enginuity 5876, or HYPERMAX OS 5977 or later.

To rename a storage group:

Procedure

1. Select the storage system.

2. Do the following depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.

3. Select the storage group and click View Details.
4. In the Properties panel, type a new name for the storage group and click Apply.

Deleting storage groups

This procedure explains how to delete storage groups.

Before you begin:

- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.
- You cannot delete a storage group that is part of a masking view or associated with a FAST Policy.
- Before you can delete a child storage group, you must first remove it from its parent.
- When a storage group configured compliance alerts (requires HYPERMAX OS 5977 or higher) is deleted or renamed, the compliance alerts will need to be deleted manually. For instructions, refer to Deleting compliance alerts policies on page 65.

To delete a storage group:

Procedure

1. Select the storage system.
2. Do the following depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.
3. Select the storage group, click more, and select Delete.
4. Click OK.

Setting host I/O limits

Host I/O limits (quotas) is a feature that can be used to limit the amount of Front End (FE) Bandwidth and I/Os per second (IOPs) that can be consumed by a set of storage volumes over a set of director ports. The bandwidth and I/Os against the set of volumes over the set of director ports will be monitored by the Symmetrix system to ensure that it will not exceed the user specified maximum bandwidth or maximum IOPs placed on these. This feature allows you to place limits on the FE Bandwidth and IOPs consumed by applications on the storage system.

Host I/O limits are defined as storage group attributes – the maximum bandwidth (in MB per second) and the maximum IOPs (in I/Os per second). For a cascaded storage group, a host I/O limit can be added for the parent and/or the child storage group. If set for both, the child limits cannot exceed that of the parent.
The Host I/O limit for a storage group can be either active or inactive, only the active Host I/O limit can limit the FE bandwidth and IOPs of the volumes in a storage group. The Host I/O limit will become active when a provisioning view is created using the storage group and will become inactive when the view is deleted. When a view is created on a parent storage group with a Host I/O limit, the limit will be shared among all the volumes in all child storage groups.

The Host I/O limit of the storage group will apply to all the director ports of the port group in the provisioning view. The Host I/O limit is divided equally among all the directors in the port group independent of the number of ports on each director. For this reason it is recommended that you configure only one of the ports of a director in the port group.

Before you begin:

- The storage system must be running Enginuity 5876.159.102 or later, or HYPERMAX OS 5977 or later.
- For Enginuity 5876.159.102 up to HYPERMAX OS 5977, the maximum number of quotas per array is 2,000. For HYPERMAX OS 5977 and later, the maximum number is 16,000.
- For more information on setting host I/O limits, refer to the *Solutions Enabler Array Management CLI Product Guide*. This guide is part of the *Solutions Enabler Complete Documentation Set*.

To set host I/O limits:

**Procedure**

1. Select a storage system.

2. Do the following, depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.

     **Note**
     In eNAS operating environments, you can also perform this operation from Storage Groups for File page (System > System Dashboard > File Dashboard > File Storage Groups).
   - For Enginuity 5876:
     Select Storage Groups to open the Storage Group list view.

3. Select the storage group and select Set Host I/O Limits to open the Set Host I/O Limits dialog box.

4. Select and type values for one or both of the following:
   - **Set Host I/O Limit (MB/Sec)**—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
   - **Set Host I/O Limit (IO/Sec)**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec, in 100 increments.

5. To configure a dynamic distribution of host I/O limits, set Dynamic Distribution to one of the following; otherwise, leave this field set to Never (default). This feature requires Enginuity 5876.163.105 or later.
• **Always**—Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.

• **OnFailure**—Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.

6. Do one of the following:

   • Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.

   • Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Managing VP compression on storage groups

The following explains how to manage VP compression on the thin volumes in a storage group.

**Before you begin:**

This feature requires Enginuity 5876.159.102 or higher. This feature is not supported on VMAX systems running HYPERMAX OS 5977 or later.

To manage VP compression on storage groups:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups** to open the **Storage Groups** list view.
3. Select the storage group, click more , and select **VP Compression** to open the **VP Compression** dialog box.
4. Select one of the following compression actions:
   
   • **Start Compression**—Starts compressing the thin volumes in the storage group.
   
   • **Stop Compression**—Stops compressing the thin volumes in the storage group.
   
   • **Start Uncompression**—Starts uncompressing the thin volumes in the storage group.
   
   • **Stop Uncompression**—Stops uncompressing the thin volumes in the storage group.
5. Click **OK**.

### Viewing storage groups (HYPERMAX OS 5977 or later)

This procedure explains how to view storage groups on a storage system running HYPERMAX OS 5977 or higher. There are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

**Procedure**

1. Select the storage system.

   The **Storage Groups Dashboard** opens by default.
2. Do one of the following:
   - To view all storage groups on the storage system, click **Total** in the **Compliance** panel to open the **Storage Groups** list view.
   - To view only file storage groups (in eNAS environments):
     a. Select **System > System Dashboard** to open the **System** dashboard.
     b. In the **Summary** panel, click **File Dashboard** to open the **File Dashboard**.
     c. In the **Summary** panel, click **File Storage Groups** to open the **Storage Groups for File** list view.
   - To view all storage groups on the storage system, select **STORAGE > Storage Groups** to open the **Storage Groups** list view.

The following properties display:
- **Name** Name of the storage group. Parent storage groups are preceded by an arrow (>) icon. Click the icon to view child storage groups.
- **Compliance** — How well the storage group is complying with its service level, if applicable. Possible values are:
  - Critical—Storage group is performing well below service level targets.
  - Marginal—Storage group is performing below service level target.
  - Stable—Storage group is performing within the service level target.
  - Storage group has no assigned service level.
  - Compliance information is being collected.
- **SRP** — Name of SRP that the storage group belongs to, if any.
- **Service Level**—Name of the service level associated with the storage group. If there is no service level associated with the group, then file displays N/A.
- **Workload Type**—Workload associated with the storage group.
- **Capacity (GB)**—Total capacity of the storage group in GB.
- **Compression Ratio**—Current compression ratio for the storage group.
- **Snapshots**—Number of snapshots linked to the storage group.
- **Masking Views**—Number of masking views associated with the storage group.
- **# File System** — Number of file systems associated with the file storage group. This column only displays in eNAS environments.
- **# Storage Pools**—Number of storage pools associated with the file storage group. This column only displays in eNAS environments.

The following controls are available:
- **Create SG**—Creating storage groups (Enginuity 5876) on page 111.
- **Modify** — Modifying storage groups on page 118.
- **Provision Storage to Host** — Using the Provision Storage wizard (Enginuity 5876) on page 100.
- **Provision Storage for File** — Provisioning storage for file on page 830—This control only displays in eNAS environments.
- **Protect** — Protecting storage groups on page 124.
- **Manage Protection** — Managing TimeFinder/Snap sessions on page 464. Select a storage group and click Manage Protection to display a link dialog box with links to the various replication technologies applied to a storage group—TimeFinder SnapVX, TimeFinder Clone, TimeFinder Mirror, SRDF storage groups, SRDF device groups, and SRDF/Metro groups.

**Note**

if a storage group has SRDF Protection with a device group and a storage group, then two management options for SRDF are displayed.

- **Set Host I/O Limits** — Setting host I/O limits on page 136.
- **View Details** — Viewing storage group details on page 146.
- **Move to EMC CloudArray** — Moving storage groups to EMC CloudArray on page 121.
- **FAST Array Advisor** — Analyzing FAST migration on page 199.
- **Delete** — Deleting storage groups on page 136.
- **Change SRP** — Changing Storage Resource Pools for storage groups on page 130.
- **Convert to Cascaded** — Converting storage groups to cascaded on page 130.
- **Start Allocate/Free/Reclaim** — Managing thin pool allocations on page 301, Managing thin pool capacity on page 304, and Managing space reclamation on page 302.
- **Stop Allocated/Free/Reclaim** — Managing thin pool allocations on page 301, Managing thin pool capacity on page 304, and Managing space reclamation on page 302.
- **Replication QoS** — Setting copy pace (QoS) for storage groups on page 235.
- **Expand ProtectPoint** — Expanding ProtectPoint storage groups on page 329.
- **Set Volume Status** — Setting volume status on page 223.

**Viewing storage group details (HYPERMAX OS 5977 or later)**

This procedure explains how to view configuration details for storage groups on storage systems running HYPERMAX OS 5977 or later. In eNAS operating environments, there are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

**Procedure**

1. Select the storage system.

   The Storage Groups Dashboard opens by default.
2. Do one of the following:
   - To view all storage groups on the storage system, click **Total** in the **Compliance** panel to open the **Storage Groups** list view.
   - To view only file storage groups (in eNAS environments):
     a. Select **System > System Dashboard** to open the **System** dashboard.
     b. In the **Summary** panel, click **File Dashboard** to open the **File Dashboard**.
     c. In the **Summary** panel, click **File Storage Groups** to open the **Storage Groups for File** list view.
3. Select the storage group and click **View Details** to open its **details** view.
4. If not already displaying, click the **Details** tab.

The **Storage Group Configuration** view contains **Properties**, **Related Objects**, **Performance Views**, and **FAST Compliance Report** panels. In addition, for file storage groups, the **File Systems** panel displays. SnapVX, Clone, Mirror and SRDF/Metro also appear in the Related Objects Panel depending on the storage group selection. To manage protection, click the SRDF link in the Associated with section in the Related Objects panel, click **View Storage Groups** to navigate to the **SRDF Storage Group** list view for the selected storage group, and then click **Manage Protection**. Note that if an SRDF pair is manageable by a storage group and also manageable by a device group, then two management options for SRDF pairs are displayed.

The following properties display:

- **Name**—Name of the storage group. To rename the storage group, type a new name over the existing and click **Apply**. Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive. If you rename a storage group that has workload on it, you will have to wait some time before the workload is visible in the storage group's **Details** view.
- **Compliance**—How well the storage group is complying with its service level, if applicable.
- **Service Level**—Service level associated with the storage group. If there is no service level associated with the group, then this field displays N/A.
- **Workload Type**—Type of the workload associated with the storage group.
- **Storage Resource Pool**—Storage resource pool containing the storage group.
- **Total Capacity (GB)**—Total capacity of the storage group in GB.
- **Volumes**—Number of volumes in the storage group.
- **Masking Views**—Number of masking views associated with the storage group.
- **VP Saved**—The percentage of space saved on the storage group.
- **Compression**—If compression is enabled on this storage group a tick will appear. If it's disabled a horizontal dash will appear.
- **Compression ratio**—Current compression ratio for the storage group.
- **Last Updated**—Timestamp of the most recent changes to the storage group.
- **Host I/O Limit**—Whether the host I/O limit feature is enabled. For more information, see **Setting host I/O limits** on page 136.
• **Set Host I/O Limit (MB/Sec)**—Enables you to specify the maximum bandwidth.

• **Host I/O Limit (MB/Sec)**—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.

• **Set Host I/O Limit (IO/Sec)**—Enables you to specify the maximum IOPs.

• **Host I/O Limit (IO/Sec)**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec.

• **Set Dynamic Distribution**—Enables/disables dynamic distribution of host I/O limits. Possible values are:
  - **Always**—Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.
  - **OnFailure**—Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.
  - **Never**—Disables this feature (Default).

• **RecoverPoint Usage**—Indicates RecoverPoint usage.

The following controls are available:

• **Modify**—Modifying storage groups on page 118.

• **Provision Storage to Host**—Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91/Provision Storage for File—Provisioning storage for file on page 830

• **Delete**—Deleting storage groups on page 136.

• **Set New Performance Baseline Expectations**—Sets the characteristics currently measured for the previous two weeks as the new performance baseline.

• **Apply**—Applies changes made in the Properties list. For example, renaming the storage group.

• **Cancel**— Cancels changes made in the Properties list.

The Related Objects panel links you to views displaying objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Volumes - 2** will open a view listing the two volumes contained in the storage group.

The Performance panel links you to the performance monitor and analyze views for the storage group.

This panel will display with inactive links if the selected VMAX system is not registered for data collection.

The File Systems panel displays the following information:

• **File System Name**—File system name.

• **Storage Groups**—Storage groups mapped to the file system.

• **Storage Pools**—Storage pools in the file system.

• **Capacity (GB)**—Total capacity of the file system.
Viewing storage group workload (HYPERMAX OS 5977 or higher)

**Before you begin**
- To perform this operation, a Monitor role is required.
- The storage system must be local and registered for performance.

This procedure explains how to view the statistics used to compute the service level compliance of a storage group.

**Procedure**
1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Groups** panel, click **Total** to open the **Storage Groups list view**.
4. Select the storage group and click **View details** to open its details view.
5. If not already displaying, click the **Compliance** tab.

The **Workload** tab allows you to view workload details, organized into the following panels:

- **Service Level**
  The service level associated with workload (Storage Group).
- **Service Level Compliance**
  The calculated compliance of the workload as measured against its service level.
- **Capacity Trend**
  The percentage of change in the storage group capacity over the previous two weeks.

**Performance**
Links you to the performance **Analyze** and **Monitor** views for the storage group.

This panel will display with inactive links if the selected VMAX system is not registered for data collection.

**Weighted Averages**
Displays the following charts:
- **Response Time (ms)**—Displays the calculated weighted average response time in milliseconds for the storage group over the previous 4 hours and 2 weeks, against the service level value range for the storage group.
- **IOs per Sec**—Displays the calculated weighted average IOs/second for the storage group over the previous 4 hours and 2 weeks.

**CPU/Port Load Scores**
Displays the following charts:
- **% Front end** — Displays the calculated IO load scores of the storage group's front-end CPUs and ports as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.
- **% Back end** — Displays the calculated IO load scores of the storage group's back-end CPUs and ports as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.
Note
You can optionally toggle the format used to display the load scores between IOs/sec and MB/sec.

Access Density Skew Scores
Displays the load scores for the storage group in the following charts:

- % High Load — Displays the calculated skew density score for the high load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

- % Mixed Load — Displays the calculated skew density score for the mixed load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

- % Low Load — Displays the calculated skew density score for the low load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

You can toggle the format used to display the load scores between the following views:

- IOs/sec — Displays the calculated skew scores for the storage group in IOs per second.

- MB/sec — Displays the calculated skew scores for the storage group in megabytes per second.

- GB — Displays the calculated skew scores for total data throughput (in GB) for the storage group.

In general, the High load and Low load numbers should be between 25 and 175 and the Mixed load number should be between 50 and 150.

Higher skew storage groups should display the following characteristics for load (IOs/sec) and Capacity:

- IOs/sec — Higher High load numbers and lower Low load numbers.

- Capacity — Higher Low load numbers and lower High load numbers.

Lower skew storage groups should display higher Mixed load numbers and lower High load and Low load numbers for load (IOs/sec) and Capacity.

When displaying load (IOs/sec):

- Higher High load numbers indicate that it is easier for the system to provide lower than expected response time for the storage group.

- Higher Low load numbers indicate that it is more difficult for the system to keep the storage group away from SATA storage.

When displaying Capacity:

- Lower High load numbers indicate that the storage group can have low response times while using less than expected amounts of Flash storage.

- Lower Low load numbers indicate that the storage group cannot take advantage of SATA storage.

The following controls are available if the storage system is running HYPERMAX OS 5977 or higher:

- Save as Reference Workload — Creating Reference Workloads on page 106

- Reset Workload Plan — Resetting Workload Plan on page 199
Viewing storage groups (Enginuity 5876)

Procedure

1. Select the storage system.

2. Select Storage > Storage Groups to open the Storage Groups list view.

The Storage Groups list view allows you to view and manage storage groups on a VMAX system.

The following properties display:

- **Name** — Name of the storage group. Parent storage groups are preceded by an arrow (>) icon. Click the icon to view child storage groups.
- **FAST Policy** — Policy associated with the storage group.
- **Capacity (GB)** — Total capacity of the storage group in GB.
- **Volumes** — Number of volumes contained in the storage group.
- **Masking Views** — Number of masking views associated with the storage group.

The following controls are available:

- **Create SG** — Creating storage groups (Enginuity 5876) on page 111.
- **Expand** — Expanding storage groups (Enginuity 5876) on page 114.
- **Provision Storage to Host** — Using the Provision Storage wizard (Enginuity 5876) on page 100.
- **Protect** — Protecting storage groups on page 124.
- **Manage Protection** — Select a storage group and click Manage Protection to display a link dialog box with links to the various replication technologies applied to a storage group - TF Clone, TF SnapVX (for V3’s), TF Mirror, SRDF storage groups, and SRDF device groups. Note that if a storage group has SRDF Protection with a device group and a storage group, then two management options for SRDF are displayed.
- **View Details** — Viewing storage group details on page 146.
- **Migrate** — Creating a non-disruptive migration (NDM) session on page 366
- **FAST Array Advisor** — Analyzing FAST migration on page 199.
- **Delete** — Deleting storage groups on page 136.
- **Associate to FAST** — Associating FAST policies with storage groups on page 131.
- **Bind SG** — Binding/Unbinding/Rebinding thin volumes on page 315.
- **Unbind SG** — Binding/Unbinding/Rebinding thin volumes on page 315.
- **Rebind SG** — Binding/Unbinding/Rebinding thin volumes on page 315.
- **Reassociate to FAST Policy** — Reassociating FAST polices and storage groups on page 134.
- **Disassociate** — Disassociating FAST policies and storage groups on page 133.
- **Set Host I/O Limits** — Setting host I/O limits on page 136.
- **Set Optimized Read Miss** — Setting optimized read miss on page 223.
- **Pin SG** — Pinning and unpinning volumes on page 192.
Viewing storage group details

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups list view.
3. Select the storage group and click View Details to open its Details view.

The storage group Details view allows you to view and manage a storage group. It contains Properties, Related Objects, Performance Views, and FAST Compliance Report panels. Clone and Mirror also appear in the Related Objects Panel depending on the storage group selection. To manage protection, click the SRDF link in the Associated with section in the Related Objects panel, click View Storage Groups to navigate to the SRDF Storage Group list view for the selected storage group, and then click Manage Protection. Note that if an SRDF pair is manageable by a storage group and also manageable by a device group, then two management options for SRDF pairs are displayed.

Note

There are multiple ways to open this view. Depending on the one you used, some of the following properties and controls may not appear.

The following properties display:

- **Name**—Name of the storage group. To rename the storage group, type a new name over the existing and click Apply. Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.

- **FAST Policy**—Policy associated with the storage group. To associate the storage group with a different policy, select a new policy and click Apply.

- **FAST Priority**—The priority value currently assigned to the storage group within the tier. Storage groups associated with a policy are assigned a
priority value that determines the order in which the tier will service them during conflicts. Possible values range from 1 (the highest) to 3 (the lowest). To change the priority, select a new priority and click **Apply**. This field only displays when the storage group is associated with a FAST Policy.

- **Total Capacity (GB)** — Total capacity of the storage group in GB.
- **Volumes** — Number of volumes in the storage group.
- **Masking Views** — Number of masking views associated with the storage group.
- **VP Saved** — The percentage of space saved with the storage group.
- **Last Updated** — Timestamp of the most recent changes to the storage group.
- **Child Storage Groups** — Number of child storage groups contained in this (parent) storage group. This field only displays for parent storage groups.
- **Parent Storage Groups** — Number of storage groups of which this storage group is a child. This field only displays for child storage groups.
- **Host I/O Limit** — Whether the host I/O limit feature is enabled. For more information, see Setting host I/O limits on page 136.
- **Set Host I/O Limit (MB/Sec)** — Enables you to specify the maximum bandwidth.
- **Host I/O Limit (MB/Sec)** — Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
- **Set Host I/O Limit (IO/Sec)** — Enables you to specify the maximum IOPs.
- **Host I/O Limit (IO/Sec)** — Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec.
- **Set Dynamic Distribution** — Enables/disables dynamic distribution of host I/O limits. This feature requires Enginuity 5876.163.105 or later. Possible values are:
  - **Always** — Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.
  - **OnFailure** — Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.
  - **Never** — Disables this feature (Default).

The following controls are available:

- **Expand** — Expanding storage groups (Enginuity 5876) on page 114
- **Delete** — Deleting storage groups on page 136
- **Apply** — Applies changes made in the **Properties** list. For example, renaming the storage group.
- **Cancel** — Cancels changes made in the **Properties** list.

The Related Objects panel links you to views displaying objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Masking Views - 2** will open a view listing the two masking views associated with the storage group.
The Performance panel links you to the performance monitor and analyze views for the storage group.

This panel will display with inactive links if the selected storage system is not registered for data collection.

The FAST Compliance Report provides the following information:

- **Tier**—Tier name.
- **Protection**—RAID protection level.
- **Technology**—Disk technology.
- **Max SG Demand (%)**—The percentages for the storage group per tier as defined in the FAST Policy.
- **Limit (GB)**—Upper limit in GB per tier for the storage group.
- **Fast SG Used (GB)**—Current occupancy in GB of the storage group in the tier.
- **Growth (GB)**—Per the FAST policy, how much more the storage group can grow in GB on a given tier. This also indicates compliance. If the growth is negative that means the storage group has exceeded the capacity limit for this tier and is out of compliance.

### Viewing backup storage groups (HYPERMAX OS 5977 or higher)

This procedure explains how to view storage groups protected by ProtectPoint or CloudArray.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Protection Dashboard** to open the Protection Dashboard.
3. In the **Storage Group Protection** panel, click **Backup** to open the **Backup Replication** view.

The following properties display:

**Note**

Partially protected storage groups do not appear in this view. For example, after adding a volume to a storage group protected by ProtectPoint, the storage group is considered partially protected, in which case it no longer appears in this view. The storage group remains in this state until you expand it using ProtectPoint, after which it is considered fully protected, and reappears in this view.

- **State**—Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:
  - Normal—All volumes are in a normal state.
  - Warning—One or more volumes in the group are in a warning state, with none higher.
  - Error—One or more volumes in the group are in an Error state.
• **Storage Group**—Name of the storage group.
• **Snapshot**—Name of the snapshot.
• **Capacity**—Total capacity of the storage group in GB.
• **Backup Storage Group**—Name of the backup storage group.
• **Last Creation Time**—Date, time, and generation number for the snapshot.
• **SRP**—Name of the SRP (applicable for CloudArray only).
• **Creation Time**—Creation date and time (applicable for CloudArray only).

The following control is available for CloudArray:

**View Storage Group**—View the storage group information.

The following control is available for ProtectPoint:

**Manage Protection**—Select a storage group and click **Manage Protection** to display a link dialog box with links to the various replication technologies applied to a storage group—TimeFinder SnapVX, TimeFinder Clone, TimeFinder Mirror, SRDF storage groups, SRDF device groups, and SRDF/Metro groups.

### Viewing point-in-time storage groups

This procedure explains how to view storage groups protected by TimeFinder/SnapVX, TimeFinder/Clone, or TimeFinder/Mirror.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Protection Dashboard** to open the **Protection Dashboard** (applies only for storage systems running HYPERMAX OS 5977 or higher).
3. In the **Storage Group Protection** panel, click **Point in Time** to open the **Point in Time** view.

The **Point in Time** view consists of the following tabs, depending on the storage environment:

**SnapVX**

Applies only for storage systems running HYPERMAX OS 5977 or higher.

The following properties display:

• **State** — Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:

  ![Normal](image)
  Normal — All volumes are in a normal state.

  ![Warning](image)
  Warning — One or more volumes in the group are in a warning state, with none higher.

  ![Error](image)
  Error — One or more volumes in the group are in an Error state.

• **Storage Group** — Name of the storage group.
• **Capacity (GB)** — Total capacity of the storage group in GB.
• **Snapshot** — Name of the snapshot.
• **Last Creation Time** — Date, time, and generation number for the snapshot.

The following controls are available:

- **Create Snapshot** — [Creating snapshots on page 476](#)
- **Link** — [Linking to snapshots on page 479](#)
- **Restore** — [Restoring snapshots on page 482](#)
- **Unlink** — [Unlinking from snapshots on page 481](#)
- **Manage Protection** — [Viewing snapshots on page 486](#)

**Clone:**

Applies only for storage systems running 5773 or 5876. The following properties display:

- **State** — Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:
  
  📰 **Normal** — All volumes are in a normal state.

  🚨 **Warning** — One or more volumes in the group are in a warning state, with none higher.

  🚫 **Error** — One or more volumes in the group are in an Error state.

- **Storage Group** — Name of the storage group.
- **Replication Management Group** — Replication management group containing the storage group.
- **Link States** — Lists the pair states found in the management group.
- **Group Type** — Type of management group.

The following controls are available:

- **Activate** — [Activating clone copy sessions on page 452](#)
- **Recreate** — [Recreating clone copy sessions on page 453](#)
- **Split** — [Splitting clone volume pairs on page 458](#)
- **Restore** — [Restoring data from target volumes on page 456](#)
- **Manage Protection** — Select a storage group and click Manage Protection to display a link dialog box with links to the various replication technologies applied to a storage group—TimeFinder SnapVX, TimeFinder Clone, TimeFinder Mirror, SRDF storage groups, SRDF device groups, and SRDF/Metro groups.

  Note that if a storage group has SRDF Protection with a device group and a storage group, then two management options for SRDF are displayed.

**Mirror:**

The following properties display:

- **State** — Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:

  📰 **Normal** — All volumes are in a normal state.
Warning — One or more volumes in the group are in a warning state, with none higher.

Error — One or more volumes in the group are in an Error state.

- **Storage Group** — Name of the storage group.
- **Replication Management Group** — Replication management group containing the storage group.
- **Link States** — Lists the pair states found in the management group.
- **Group Type** — Type of management group.

The following controls are available:
- **Establish**—Creating Snapshots on page 493.
- **Restore**—Restoring BCV pairs on page 494
- **Split**—Splitting BCV pairs on page 495
- **Cancel**—Cancelling BCV pairs on page 496
- **Manage Protection**—Select a storage group and click Manage Protection to display a link dialog box with links to the various replication technologies applied to a storage group—TimeFinder SnapVX, TimeFinder Clone, TimeFinder Mirror, SRDF storage groups, SRDF device groups, and SRDF/Metro groups.

Note that if a storage group has SRDF Protection with a device group and a storage group, then two management options for SRDF are displayed.

### Viewing remote replication storage groups

This procedure explains how to view storage groups protected by SRDF. Note that for the Protection Dashboard showing SRDF protected SGs, only R1 SGs appear in the Application Protection section and Storage Group Protection counts. An R2 SG appears in the SG Protection count and Application Protection list, if it is an R1 in an R21 setup.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Protection Dashboard to open the Protection Dashboard (applies only for storage systems running HYPERMAX OS 5977 or higher).
3. In the Storage Group Protection panel, click Remote Replication to open the Remote Replication view.

The following properties display:

- **State** — Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:
  - **Normal** — All pairs are in a normal state.
  - **Warning** — One or more pairs in the group are in a warning state, with none higher.
Error — One or more pairs in the group are in an Error state.

- **Storage Group** — Name of the storage group.
- **Replication Management Group** — Replication management group associated with the storage group.
- **Link States** — State of the SRDF links.
- **Multiple Replicas** — SRDF configuration.

The following controls are available:

- **Establish** — Establishing SRDF pairs on page 536
- **Split** — Splitting SRDF pairs on page 550
- **Suspend** — Suspending SRDF pairs on page 551
- **Restore** — Restoring SRDF pairs on page 547
- **Resume** — Resuming SRDF links on page 543
- **Failover** — Failing over on page 537
- **Failback** — Failing back on page 538
- **Manage Protection** — Select a Storage Group and click Manage Protection to navigate to the SRDF Storage Group List view displaying the SRDF storage groups.

### Viewing high availability storage groups (HYPERMAX OS 5977 or higher)

This procedure explains how to view high availability SRDF/Metro storage groups.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Protection Dashboard to open the Protection Dashboard (applies only for storage systems running HYPERMAX OS 5977 or higher).
3. In the Storage Group Protection panel, click High Availability to open the Remote Replication view.

The following properties display:

- **State** — State severity of the SRDF/Metro storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:
  - Normal — All pairs are in a normal state.
  - Warning — One or more pairs in the group are in a warning state, with none higher.
  - Error — One or more pairs in the group are in an error state.

- **Storage Group** — Name of the storage group.
- **Replication Management Group** — Replication management group associated with the storage group.
**Link States**—State of the SRDF links.

**Bias Location**—Bias location.

The following controls are available:

- **Establish**—Establishing SRDF pairs on page 536
- **Suspend**—Suspending SRDF pairs on page 551
- **Restore**—Restoring SRDF pairs on page 547
- **Set Bias Location**—Setting bias location on page 548
- **Manage Protection**—Select a Storage Group and click **Manage Protection**—to navigate to the SRDF/Metro Storage Group List view displaying the SRDF/Metro storage groups.

### Viewing total storage groups

This procedure explains how to view all storage groups on a storage system, regardless of whether they are protected:

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Protection Dashboard** to open the **Protection Dashboard** (applies only for storage systems running HYPERMAX OS 5977 or higher).
3. In the **Storage Group Protection** panel, click **Total** to open the **All Storage Groups** list view.

The following properties display:

- **Storage Group**—Name of the storage group. Parent storage groups are preceded by an arrow (>) icon. Click the icon to view child storage groups.
- **Capacity (GB)**—Total capacity of the storage group in GB.
- **Service Level**—Service level associated with the storage group.
- **Masking Views**—Number of masking views associated with the storage group.

The following controls are available:

- **Protect**—Protecting storage groups on page 124
- **Manage Storage Groups**—Managing storage groups (HYPERMAX OS 5977 or later) on page 107
- **Set SRDF GCM**—Setting the SRDF GCM flag on page 548
- **Reset SRDF/Metro Identity**—Resetting original device identity on page 546
- **Set Volume Status**—Setting volume status on page 549

### Viewing unprotected storage groups

This procedure explains how to view unprotected storage groups.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Protection Dashboard to open the Protection Dashboard.

3. In the Storage Group Protection panel, click Unprotected to open the Unprotected Storage Groups list view.

   The following properties display:
   - **Storage Group**—Name of the storage group. Parent storage groups are preceded by an arrow (>) icon. Click the icon to view child storage groups.
   - **Capacity (GB)**—Total capacity of the storage group in GB.
   - **Masking Views**—Number of masking views associated with the storage group.

   The following controls are available:
   - **Protect**—Protecting storage groups on page 124
   - **Manage Storage Groups**—Managing storage groups (HYPERMAX OS 5977 or later) on page 107

Viewing cascaded storage groups

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups list view.
3. Select the storage group and click View Details to open its Details view.
4. Optional: In the Related Object panel, click Child Storage Groups to open the Child Storage Groups list view.
5. Optional: Use the Child Storage Groups list view to view and manage cascaded storage groups.
6. The following properties (depending on the storage operating environment) display:
   - **Name**—Name of the storage group.
   - **Compliance**—Indicates Compliance status.
   - **SRP**—SRP associated with the storage group.
   - **Service Level**—Service level associated with the storage group.
   - **Parent**—Indicates if this storage group is the parent of a cascaded storage group.
   - **FAST Policy**—Policy associated with the storage group.
   - **Capacity (GB)**—Total capacity of the storage group in GB.
   - **Compression Ratio**—Compression ratio associated with the storage group.
   - **Snapshots**—Number of snapshots associated with the storage group.
   - **Volumes**—Number of volumes contained in the storage group.
   - **Masking Views**—Number of masking views associated with the storage group.
   - **Child Storage Group**—Number of child storage groups contained in this (parent) storage group.
   - **Workload Type**
7. The following controls are available:
   - **Add Storage Group**—Adding or removing cascaded storage groups on page 134
   - **Remove**—Adding or removing cascaded storage groups on page 134
   - **View Details**—Viewing storage group details on page 146

Viewing volumes in storage groups

Procedure
1. Select the storage system.
2. Do the following, depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select *Storage* > *Storage Groups Dashboard* to open the *Storage Groups Dashboard*.
     b. In the *Storage Groups* panel, click *Total* to open the *Storage Groups* list view.
   - For Enginuity 5876:
     Select *Storage* > *Storage Groups* to open the *Storage Group* list view.
3. Select the storage group and click *View Details* to open its *Details* view.
4. In the *Related Object* panel, click *Volumes* to open the *Volumes* list view.
   Use the *Volumes* list view to view and manage the volumes in a storage group.
5. The following properties display:
   - **Name**—Assigned volume name.
   - **Type**—Type of volume.
   - **Emulation**—Emulation type for the volume.
   - **Allocated %**—Percentage allocated.
   - **Capacity (GB)**—Volume capacity in Gigabytes.
   - **Pool State**—State of the pool.
   - **Status**—Volume status.
   - **Reserved**—Whether the volume is reserved.
   - **Pinned**—Whether the volume is pinned. Pinning volumes prevents any automated process such as FAST or Optimizer from moving them.
   - **Multiple SGs**—Whether the volume is in multiple storage groups (Yes/No).

The following controls are available, depending on the storage operating environment:
   - **Create Volumes**—Creating volumes on page 205.
   - **Add Volumes to SG**—Adding volumes to storage groups on page 111.
   - **Remove Volumes**—Removing volumes from storage groups on page 114.
   - **Copy Volumes to SG**—Copying volumes between storage groups on page 112.
   - **View Details**—Viewing details on a volume in a storage group on page 156.
• Move Volumes to SG—Moving volumes between storage groups on page 113.

• Tag for Recover Point—Tagging and untagging volumes for Recoverpoint (volume level) on page 584 (Only available on storage systems running 5876).

• Untag for Recover Point—Tagging and untagging volumes for Recoverpoint (volume level) on page 584 (Only available on storage systems running 5876).

• Map—Mapping volumes on page 221.

• Unmap—Unmapping volumes on page 222.

• z/OS Map—z/OS map from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 423 and z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 428.

• z/OS Unmap—z/OS unmap from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 424 and z/OS unmap FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 429.

• Bind—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876).

• Unbind—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876).

• Rebind—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876).

• Change Volume Configuration—Changing volume configuration on page 219.

• Set Volume Attributes—Setting volume attributes on page 224.

• Set Volume Identifiers—Setting volume identifiers on page 225.

• Set Volume Status—Setting volume status on page 223.

• Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 234 (Only available on storage systems running 5876).

• Assign Symmetrix Priority—Assigning Symmetrix priority to individual volumes on page 218 (Only available on storage systems running 5876).

• Start Allocate/Free/Reclaim—Managing thin pool allocations on page 301 and Managing space reclamation on page 302.

• Stop Allocate/Free/Reclaim—Managing thin pool allocations on page 301 and Managing space reclamation on page 302.

• Replication QoS—QOS for replication on page 235.

• Pin—Pinning and unpinning volumes on page 192 (Only available on storage systems running 5876).

• Unpin—Pinning and unpinning volumes on page 192 (Only available on storage systems running 5876).

Viewing details on a volume in a storage group

Procedure

1. Select a storage system.
2. Do the following, depending on the storage operating environment:

For HYPERMAX OS 5977 or later:

- Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
- In the Storage Groups panel, click Total to open the Storage Groups list view.

For Enginuity 5876:

- Select Storage > Storage Groups to open the Storage Group list view.

3. Select the storage group and click View Details to open its Details view.

4. In the Related Object panel, click Volumes to open the Volumes list view.

5. Select a volume and click View Details to open its Details view.

6. Use the volume Details view to display and manage a volume in a storage group. This view contains two panels, Properties, and Related Objects.

Properties panel
The following properties display:

- Name—Volume name.
- Physical Name—Physical name.
- Volume Identifier—Volume identifier.
- Type—Volume configuration.
- Encapsulated Volume—Whether external volume is encapsulated. Relevant for external disks only.
- Encapsulated WWN—World wide name for encapsulated volume. Relevant for external disks only.
- Status—Volume status.
- Reserved—Whether the volume is reserved.
- Capacity (GB)—Volume capacity in GBs.
- Capacity (MB)—Volume capacity in MBs.
- Capacity (Cylinders)—Volume capacity in cylinders.
- Emulation—Volume emulation.
- Compression ratio—Current compression ratio for the volume.
- Symmetrix ID—Storage system on which the volume resides.
- Symmetrix Volume ID—Symmetrix volume name/number.
- HP Identifier Name—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- VMS Identifier Name—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- Nice Name—Nice name generated by Symmetrix Enginuity.
- WWN—World Wide Name of the volume.
- DG Name—Name of the device group in which the volume resides, if applicable.
- CG Name—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)**—Geometry capacity in GBs.
- **Geometry Limited**—Indicates whether an encapsulated volume has a Symmetrix cylinder size larger than the reported user-defined geometry.
- **SSID**—Subsystem ID.
- **Capacity (Tracks)**—Capacity in tracks.
- **SA Status**—Volume SA status.
- **Host Access Mode**—Host access mode.
- **Pinned**—Whether the volume is pinned.
- **RecoverPoint tagged**—Indicates whether volume is tagged for RecoverPoint.
- **Service State**—Service state.
- **Defined Label Type**—Type of user-defined label.
- **Dynamic RDF Capability**—RDF capability of the volume.
- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status**—Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
- **Priority GoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Copy Pace - RDF**—Copy pace priority during SRDF operations.
- **Copy Pace - Mirror Copy**—Copy pace priority during TimeFinder/Mirror operations.
- **Copy Pace - Clone**—Copy pace priority during TimeFinder/Clone operations.
- **Copy Pace - VLUN**—Copy pace priority during VLUN migration operations.
- **Dynamic Cache Partition Name**—Name of the cache partition.
- **XtremSW Cache Attached**—Indicates whether XtremSW cache is attached to the volume.
- **Optimized Read Miss**—Cacheless read miss status.
The following controls are available, depending on the storage operating environment:

- **Remove**—Removing volumes from storage groups on page 114
- **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583 (Only available on storage systems running 5876)
- **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583 (Only available on storage systems running 5876)
- **Map**—Mapping volumes on page 221
- **Unmap**—Unmapping volumes on page 222
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876)
- **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876)
- **Rebind**—Binding/Unbinding/Rebinding thin volumes on page 315 (Only available on storage systems running 5876)
- **Change Volume Configuration**—Changing volume configuration on page 219
- **Set Volume Attributes**—Setting volume attributes on page 224
- **Duplicate Volume**—Duplicating volumes on page 217
- **Set Volume Identifiers**—Setting volume identifiers on page 225
- **Set Volume Status**—Setting volume status on page 223
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896 (Only available on storage systems running 5773 or 5876)
- **Assign Symmetrix Priority**—Assigning Symmetrix priority to individual volumes on page 218
- **Replication QoS**—QOS for replication on page 235
- **Start Allocate/Free/Reclaim**—Start Allocate/Free/Reclaim dialog box on page 313
- **Stop Allocate/Free/Reclaim**—Stop Allocate/Free/Reclaim dialog box on page 313
- **Pin**—Pinning and unpinning volumes on page 192 (Only available on storage systems running 5876)
- **Unpin**—Pinning and unpinning volumes on page 192 (Only available on storage systems running 5876)

**Related Objects** panel

The Related Objects panel provides links to views for objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Front End Paths - 2** will open a view listing the two front-end paths associated with the volume.

**Select Storage Resource Pool**

Use this dialog box to select a Storage Resource Pool for the operation.
Note
To create the storage group outside of FAST control, set Storage Resource Pool to None; otherwise, leave this field set to the default.

Select SSID

Use this dialog box to select an SSID for the operation.

Task in Progress

Use this dialog box to monitor the progress of a configuration change operation.

Procedure
1. To view detailed information, click Show Task Details. Once a task completes, a success or failure message displays.

Select SRDF group

Use this dialog box to select a SRDF group.

Modify Custom Capacity dialog box

Use this dialog box to modify the capacity of a storage group with mixed capacities.

To modify the capacity of the storage group, type new values for the volumes and click OK to return to the Modifying Storage Groups dialog box.

Understanding FAST (HYPERMAX OS 5977)

Note
This section describes FAST operations for storage systems running HYPERMAX OS 5977. Understanding FAST (Enginuity 5876) on page 172 describes FAST operations on storage systems running Enginuity 5876.

Fully Automated Storage Tiering (FAST) automates management of storage system disk resources on behalf of thin volumes. FAST automatically configures disk groups to form a Storage Resource Pool by creating thin pools according to each individual disk technology, capacity and RAID type.

FAST technology moves the most active parts of your workloads (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives, leveraging the best performance and cost characteristics of each different drive type. FAST delivers higher performance using fewer drives to help reduce acquisition, power, cooling, and footprint costs. FAST is able to factor in the RAID protections to ensure write heavy workloads go to RAID 1 and read heavy workloads go to RAID 6. This process is entirely automated and requires no user intervention.

FAST further provides the ability to deliver variable performance levels through service levels. Thin volumes can be added to storage groups and the storage group can be associated with a specific service level to set performance expectations.

FAST monitors the storage groups performance relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.
On storage systems running HYPERMAX OS 5977 or higher, FAST is always on. The VMAX Family Product Guide provides additional details about FAST operations in this storage environment.

Understanding service levels

A service level is the response time target for the storage group. The service level allows you set the VMAX array with the desired response time target for the storage group. It automatically monitors and adapts to the workload in order to maintain (or meet) the response time target. The service level includes an optional workload type so you can further tune expectations for the workload storage group to provide just enough flash to meet your performance objective.

Renaming Service Levels

Before you begin
- To perform this operation, you must be a StorageAdmin.
- This feature requires HYPERMAX OS 5977 or higher.
- The service level must be unique from other service levels on the storage system and cannot exceed 32 characters. Only alphanumeric characters, underscores ( _ ), and hyphens (-) are allowed. However, service level names cannot start or end with an underscore or hyphen.

Once a service level is renamed, all active management and reporting activities will be performed on the newly named service level. The original, pre-configured service level name will be maintained in the Service Level View for future reference. All other references to the original service level will display the new name.

Procedure
1. Select the storage system.
2. Select Storage > Storage Levels to open the Service Level view.
3. Hover the cursor over the service level and click Edit ( 
4. Type the new name over the existing name.
5. Click OK.

Reverting to original service level names

Before you begin
- To perform this operation, you must be a StorageAdmin.
- This feature requires HYPERMAX OS 5977 or higher.
- The service level must be unique from other service levels on the storage system and cannot exceed 32 characters. Only alphanumeric characters, underscores ( _ ), and hyphens (-) are allowed. However, service level names cannot start or end with an underscore or hyphen.

Procedure
1. Select the storage system.
2. Select Storage > Service Levels to open the Service Level view.
3. Hover the cursor over the service level and click Edit ( 

4. Type the original, pre-configured name.
5. Click OK.

Viewing service levels

Before you begin
This feature requires HYPERMAX OS 5977 or higher.

A service level is the response time target for the storage group. The service level allows you set the VMAX array with the desired response time target for the storage group. It automatically monitors and adapts to the workload in order to maintain (or meet) the response time target. The service level includes an optional workload type so you can further tune expectations for the workload storage group to provide just enough flash to meet your performance objective.

Procedure
1. Select the storage system.
2. Select Storage > Service Levels to open the Service Level view.
   The Workload Types tab displays information about the available workload types.
   Available service levels appear in white and unavailable appear grayed-out.
   For all-flash storage systems, the only service level available is Diamond.
3. Optional: In a mixed FBA/CKD environment, select the emulation type from the Emulation List box.
   The service levels available update automatically.
   If the emulation type is set to CKD, the Workload Types tab is not available.
4. Optional: To rename a service level, hover the cursor over the service level and click Edit (📝). Type the new name over the existing name.
5. Optional: To provision storage using a service level, hover the cursor over the service level and click Provision Storage.
   This will open the Provision Storage to Host wizard, with the service level and Storage Resource Pool already selected. For more information on using the wizard, refer to its help page.
6. To view details on the Expected Average Response Times, click Show Details.
   Response time details for each Service Level display. Where OLTP workload is focused on optimizing performance for small block I/O and DSS workload is focused on optimizing performance for large block I/O. The Workload Type can also specify whether to account for any overhead associated with replication (OLTP_Rep and DSS_Rep, where denotes replication).

Understanding Storage Resource Pool details

Storage Resource Pool is a collection of data pools that provide FAST a domain for capacity and performance management. By default, a single default Storage Resource Pool is factory pre-configured. Additional Storage Resource Pools can be created with a service engagement. FAST performs all its data movements within the boundaries of the Storage Resource Pool.
Modifying Storage Resource Pool details

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- You must have Administrator or StorageAdmin permission.

Procedure

1. Select the storage system.
2. Select **Storage** > **Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Resource Pools** panel, under **Reports**, click **View SRP Details** to open the **SRP Details** view.
4. Modify any number of the following:
   - **Name**—Name of the storage resource pool. To change this value, type a new description and click **Apply**. The name of the storage resource pool must be unique and it cannot exceed 32 characters. It can include only alphanumeric, underscore, and hyphen characters, but cannot begin with an underscore or hyphen character.
   - **Description**—Optional description of the pool. To change this value, type a new description and click **Apply**. The description cannot exceed 127 characters. It can contain only alphanumeric, hyphen, underscore, space, period, and comma characters.
   - **Reserved Capacity % (0 - 80)**—The percentage of the capacity of the Storage Resource Pool to be reserved for volume write I/O activities. Valid values for the percentage are from 1 to 80. NONE disables it. For example, if you set the reserved capacity on a Storage Resource Pool to 30%, then the first 70% of the pool capacity is available for general purpose operations (host I/O allocations, local replication tracks and SRDF/A DSE allocations) and the final 30% of the pool capacity is reserved strictly for volume write I/O activities. Note that existing TimeFinder snapshot sessions created on volumes in the Storage Resource Pool are invalid if the free capacity of the Storage Resource Pool, as a percentage of the usable capacity, goes below the reserved capacity.
   - **Usable by RDFA DSE**—Specifies whether the Storage Resource Pool can be used for SRDF/A DSE operations. This field does not display for external SRPs. The maximum amount of storage from a Storage Resource Pool that can be used for DSE is controlled by the system wide dse_max_cap setting, as described in the *Solutions Enabler SRDF Family CLI User Guide*.
5. Click **Apply**.

Viewing Storage Resource Pools

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- This procedure explains how to open the **Storage Resource Pool** view from the main menu. You can also open it from **Storage Groups Dashboard**.

Procedure

1. Select the storage system.

3. Select the tab for the storage resource pool you want to view.

The Storage Resource Pool view allows you to view and manage storage resource pools. It contains Properties, Related Objects, and panels.

**Properties panel**

The following properties display:

- **Name** — Name of the storage resource pool. To change this value, type a new description and click **Apply**. The name of the storage resource pool must be unique and it cannot exceed 32 characters. It can include only alphanumeric, underscore, and hyphen characters, but cannot begin with an underscore or hyphen character.
- **Description** — Optional description of the pool. To change this value, type a new description and click **Apply**. The description cannot exceed 127 characters. It can contain only alphanumeric, hyphen, underscore, space, period, and comma characters.
- **Default Emulation** — The default emulation for the pool (FBA or CKD).
- **Overall Efficiency** — The current compression efficiency on this storage resource pool.
- **Compression State** — Indicates whether compression is enabled or disabled for this storage resource pool.
- **Effective Used Capacity (%)** — The effective used capacity, expressed as a percentage.
- **Usable Capacity (GB)** — Usable capacity of all the disk groups in the Storage Resource Pool, excluding any external disk groups used for FTS encapsulation.
- **Allocated Capacity (GB)** — Sum of the volume allocations, snapshot allocations, and SRDF/A DSE allocations on the Storage Resource Pool.
- **Free Capacity (GB)** — Difference between the usable and allocated capacities.
- **Subscription (GB)** — Percentage of the configured sizes of all the thin volumes subscribed against the Storage Resource Pool.
- **Reserved Capacity % (0 - 80)** — Percentage of the **Usable Capacity** that will be reserved for non-snapshot activities. Existing TimeFinder snapshot sessions created on volumes in the Storage Resource Pool can go invalid if the Free Capacity of the Storage Resource Pool, as a percentage of the Usable Capacity, goes below the Reserved Capacity. To change this value, type a new value over the old, and click **Apply**.
- **Usable by RDFA DSE** — Specifies whether the Storage Resource Pool can be used for SRDF/A DSE operations. This field does not display for external SRPs.

The following controls are available:

- **Apply** — Applies changes made in the **Properties** list. For example, changing the Reserved Capacity %.
- **Cancel** — Cancels changes made in the **Properties** list.
- **Add eDisk** — Adding external disks on page 332

**Related Objects panel**

The Related Objects panel links you to views displaying objects contained in the pool. Each link is followed by a number, indicating the number of objects in
Changing Storage Resource Pools for storage groups

This procedure explains how to change the Storage Resource Pool of a parent storage group, with child service levels using different Storage Resource Pools. This procedure explains how to perform this operation from the Storage Groups Dashboard. In eNAS environments, you can also perform this operation from the File Storage Groups page (System > System Dashboard > File Dashboard > File Storage Groups).

Before you begin:

- The storage system must be running HYPERMAX OS 5977 or later.
- You must have Administrator or StorageAdmin permission.

To change the Storage Resource Pool for storage groups:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.
3. Select the storage group, click more, and select Change SRP to open the Change SRP dialog box.
4. Select the new SRP.
5. (Optional) Change the Service Level for the SG. Service levels specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual</td>
</tr>
</tbody>
</table>

the corresponding view. For example, clicking Service Levels - 2 will open a view listing the two service levels in the storage resource pool.

Disk Groups panel

The Disk Groups panel lists details on the disk groups in the SRP, including:

- Name of the disk group. For external disk groups, clicking on the disk group name opens a list of external disks. For more information, refer to Viewing external disks on page 331.
- Vendor—Vendor and product ID.
- Speed (RPM)—Speed of the disks in the disk group.
- Usable Capacity (GB)—Usable capacity in the disk group.
- Disk Location—Specifies if the disk group is internal or external.
### Service level compliance

Each service level and workload type has a response band associated with it. When a storage group (workload) is said to be compliant, it means that it is operating within the associated response time band.

When assessing the compliance of a storage group, Workload Planner calculates its weighted response time for the past 4 hours and for the past 2 weeks, and then compares the two values to the maximum response time associated with its given service level. If both calculated values fall within (under) the service level defined response time band, the compliance state is STABLE. If one of them is in compliance and the other is out of compliance, then the compliance state is MARGINAL. If both are out of compliance, then the compliance state is CRITICAL.

### Creating Compliance Reports

This procedure explains how to create Compliance reports. Compliance Reports allow you to view storage group performance against service levels over a period of time.

Before you begin:

- This feature requires HYPERMAX OS 5977 or later.
- The user must be a StorageAdmin permissions or higher.

To create Compliance Reports:

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the Storage Resource Pools panel, under Reports, click Compliance Report to open the report.
4. Click Schedule to open the Create Report dialog box.
5. On the General tab, do any number of the following:
   - Type a Name for the report.

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.
b. Type a **Description** for the report.
c. Select the time zone in which the report will be generated (**Generated Time Zone**).

6. On the **Schedule** tab, do any number of the following:
   a. Select the **First Runtime**.
   b. Select the **Day(s) to Run**.
   c. Select the number of days that the report should be retained (**Retention (Days)**).

7. On the **Email** tab, select **Send report to** and type an email address.

8. Click **OK**.

**Viewing compliance reports**

This procedure explains how to view storage group performance against service levels over a period of time.

Before you begin:

- This feature requires HYPERMAX OS 5977 or later.
- The user must be a StorageAdmin permissions or later.

To view service level compliance reports:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Resource Pools** panel, under **Reports**, click **Compliance Report** to open the report.
4. Customize the report by doing the following:
   a. Select to view **All Service Levels** or a specific service level.
   b. Select the time period. For the time period you select, the storage group's compliance is assessed in 30 minute intervals, and then its overall compliance state is displayed based on the method described in **Service level compliance** on page 166. For example, if you select **Last 24 hours**, the storage group's compliance state is assessed 48 times, and then its calculated compliance state is displayed in this report.
   c. Select whether to view the compliance information as a chart or numerical display.

The following properties display:

- **Storage Group**—Name of the storage group.
- **Service Level**—Service level associated with the storage group.
- **% Stable**—Percentage of time the storage group performed within the service level target.
- **% Marginal**—Percentage of time the storage group performed below the service level target.
% Critical—Percentage of time the storage group performed well below the service level target.

The following controls are available:
- **Save As**—Save the report as a JPG, PNG, or PDF file.
- **Schedule**—Exporting the Storage Group Demand Reports on page 171.
- **Monitor**—Monitoring storage systems on page 818

Save Report Results dialog box
Use this dialog box to save service level compliance reports in PDF.

Managing Data Exclusion Windows

This procedure explains how to manage Data Exclusion Windows for calculating headroom and suitability.

Peaks in storage system statistics can occur due to:
- anomalies or unusual events
- recurring maintenance during off-hours that fully loads the storage system

Due to the way this data is condensed and used, unexpected headroom and suitability results can occur.

There are two ways to improve the handling of these cases:
- **One-time exclusion period**—when the one-time exclusion period value is set, all statistics before this time are ignored. This helps resolve the first case above, where a significant one time peak distorts the results due to reliance on two weeks of data points. This is set system-wide for all components.
- **Recurring exclusion period**—You can select n of 42 buckets to use in admissibility checks. This is set system-wide for all components. Recurring exclusion periods are repeating periods of selected weekday or time slot combinations where collected data is ignored for the purposes of compliance and admissibility considerations. The data is still collected and reported, but it is not used in those calculations.

Before you begin:
- This feature requires HYPERMAX OS 5977 or higher.
- The user must have StorageAdmin permissions or higher.

To manage Data Exclusion Windows:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Group Management** panel, under **Manage**, click **Compliance Settings** to open the page.

The **Compliance Settings** page allows you to view and set the one-time exclusion period and recurring exclusion periods for a selected storage system. It consists of two panels. The **One-time Exclusion Period** panel displays 84 component utilizations (two weeks worth of data) in a single chart that allows you to set the one-time exclusion period value from a given time slot, resulting in all time slots prior to the selected time slot being ignored for the purposes of calculating compliance and admissibility values. The **Recurring Exclusion**
Periods panel displays the same data, but in a one-week format that allows you to select repeating recurring exclusion periods during which any collected data is ignored.

Each bar in the chart represents a utilization score calculated for that time slot. The score itself is the highest value of four component types, that is, the “worst performing” of the four components is the one that determines the overall value returned. The exact type and identifier of the selected component can be seen in the tool tip for a specific bar. The four component types that are represented in the bars are:

- Front End Port
- Back End Port
- RDF Port
- Thin Pool

The bars in both panels represent the same data using the same color coding scheme. The colors of the bars signify the following states:

- Green represents a utilization value that meets the best practice limit.
- Red represents a utilization value that exceeds the best practice limit.
- Blue represents a utilization value this is being ignored before the one-time exclusion period.
- Gray represents a utilization value that is being ignored as part of a window.

No Bar – If no data was collected or calculated during a time slot, there is no bar present.

The One-time Exclusion Period panel consists of a chart that is labeled with the component utilization value as the y-axis and the time slot as the x-axis. Each time slot is a four hour window during which data was collected and a utilization score was calculated. There is also a horizontal line representing the best practice utilization of 100%. The y-axis is labeled with the dates of the time slots, that is, the dates of the midnight time slots are labeled with that date and other time slots are blank.

The top-right of this panel has a filter which allows you to include all components used in utilizations calculations or filter for only those used in headroom calculations. This can be helpful when headroom values are causing suitability problems in other areas, but those issues are masked by other component utilizations on this chart. The filters are: All components, for suitability (the default selection) and Back-end components only, for headroom. When you select a value, the page is reloaded with data from the server, filtered according to the selection made. Both charts are updated to reflect this data.

When the user selects a value the page will be reloaded with data from the server, filtered according to the selection made. Both charts will be updated to reflect this data.

You can select and set a time slot before which all collected data will be ignored. You select the time slot by clicking on the desired bar. The selected bar and all previous bars are changed to the one-time exclusion period coloring reflecting this selection. In addition, one-time exclusion period selection is also dynamically displayed in the Recurring Exclusion Periods chart as selections are made. If you try to set the selection to the last bar on the right an error is displayed and the action will not be allowed.
deselect a selected bar by clicking it again. The chart then reverts to the value set when the page was loaded.

One-time exclusion period bars are only displayed in the **Recurring Exclusion Periods** chart under these conditions:

- Both buckets corresponding to the Recurring Exclusion Periods chart slot are before the one-time exclusion period.
- One of the buckets is before the one-time exclusion period and the other bucket has no data collected.

The panel has two buttons to set and clear any changes made:

- **Set One-time Exclusion**—writes the selected one-time exclusion period value to the database. This value will then be in effect and will be shown in all future views of this page. This button is enabled when a one-time exclusion period is selected. Clicking OK confirms the operation.
- **Clear One-time Exclusion**—clears any previously set one-time exclusion value. This button is only enabled if a one-time exclusion value is set when the page is first loaded. Clicking OK confirms the operation.

The **Recurring Exclusion Periods** panel consists of seven charts, one for each day of the week. Each chart has a bar for each four hour time slot during which data is collected and a utilization score is calculated. Each bar represents two bars shown in the **One-time Exclusion Period Panel** chart. The bar shown in this chart is the highest value (“worst performing”) bar of the two One-time Exclusion Period Panel bars.

One-time exclusion period bars are only displayed in the **Recurring Exclusion Periods** chart under the following conditions:

- Both buckets corresponding to the Recurring Exclusion Periods chart slot are in the one-time exclusion period.
- One of the buckets is in the one-time exclusion period and the other bucket has no data collected.

In this panel, you click a time slot to select or deselect it. Clicking on a selected time slot will deselect it. As selections are made, both charts will be dynamically updated with the appropriate color coding.

The panel has two buttons to set and clear any changes made:

- **Set Recurring Exclusions**—writes the selected recurring exclusions period value(s) to the database. These values will then be in effect and will be shown in all future views of this page. This button is enabled when a recurring exclusion period is selected. Clicking OK confirms the operation.
- **Clear Recurring Exclusions**—clears any previously set recurring exclusion period values. This button is only enabled if a recurring exclusion period value is set when the page is first loaded. Clicking OK confirms the operation.

At the bottom of the page is a panel that contains the legend indicating the meanings associated with the different bar colors. On the right hand side in this panel is text detailing the last time a one-time exclusion period or Window was changed. If you hover over this text, the name of the user (fully qualified user name) that performed the last update operation is displayed. If the database has never had a one-time exclusion period or Window set, the field and tool tip text displays “Not yet modified”.

**Alerts**
There is a system alert generated each time a user changes a one-time exclusion period value or a recurring exclusion period value.

Storage group and workload demand reports

Viewing Storage Group Demand Reports

This procedure explains how to view storage groups on an SRP and their associate workloads.

If the list view is launched from a Storage Resource Pools panel where a CKD/FBA filter had been applied, that filter continues to be applied to the Storage Group Demand Report list.

Before you begin:
This feature requires HYPERMAX OS 5977 or higher.

To view storage group demand reports:

Procedure
1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. Optional: Filter by Storage Group Name and Emulation.
4. In the Storage Resource Pools panel, under Reports, click Storage Group Demand Report to open the report.

Some or all of the following properties display:
- **Storage Group**—Name of the storage group.
- **Subscription (GB)**—Amount of SRP capacity to which the storage group subscribed.
- **Allocated (%)**—The percentage of allocated pool capacity.
- **Emulation**—Emulation type. This displays only if the storage system is capable of containing CKD devices.
- **SNAP Allocated (%)**—The percentage allocated to snap.

The following control is available:
- **Export Report**—Exporting the Storage Group Demand Reports on page 171.

Exporting the Storage Group Demand Reports

This procedure explains how to export a portable document format (PDF) version of the Storage Group Demand Report:

Procedure
1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the Storage Resource Pools panel, under Reports, click Storage Group Demand Report to open the report.
5. Click **OK**.
6. Select a location for the download and click **Save**.

**Viewing Workload Demand Reports**

This procedure explains how to view demand that each workload is placing on the SRP.

Before you begin:
This feature requires HYPERMAX OS 5977 or higher.
For mixed CKD/FBA SRPs, workload demand reports are displayed only when FBA emulation is selected.

To view workload demand reports:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard**.
3. In the **Storage Resource Pools** panel, under **Reports**, click **Workload Demand Report** to open the report.

Some or all of the following properties display:

- **Name**
  - Name of the workload.

- **Subscribed (GB)**
  - Total space that the workload has subscribed on the SRP in GB.

- **Subscription (%)**
  - Percentage of space that the workload has subscribed on the SRP.

- **Allocated (GB)**
  - Total space that the workload has allocated on the SRP in GB.

**Understanding FAST (Enginuity 5876)**

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**Note**

This section describes FAST operations for storage systems running Enginuity 5876. It describes FAST operations on storage systems running HYPERMAX OS 5977 or higher.

Fully Automated Storage Tiering (FAST) is software that runs background algorithms to continuously analyze the utilization (busy rate) of the storage system volumes. The FAST controller processes the algorithm data, and generates plans for moving and swapping data volumes to fine tune performance and reduce costs. FAST can move the most-used data to the fastest (and most expensive) storage, such as Enterprise Flash Drives (EFD), the least-used data to the slowest (and least expensive) storage, such as SATA drives, while maintaining the remaining data on Fibre Channel (FC) drives, based on user-defined Symmetrix tiers and FAST policies. The objective of tiered storage is to minimize the cost of storage, while improving or maintaining performance, by putting the right data, on the right Symmetrix tier, at the right time.

Enginuity 5876 introduced Federated Tiered Storage (FTS), which allows the virtualization of external storage as an external disk (eDisk). Adding the eDisk to the Symmetrix system makes its capacity available to the Symmetrix system as an
external spindle. FAST VP supports tiers of externally provisioned VP pools. Encapsulated volumes are not supported. There is no support for externally provisioned or encapsulated (standard) volumes with FAST. The new order for the fastest to the slowest tiers is EFD, FC, SATA, and external tiers.

Enginuity 5876.159.102 or higher supports associating FTS tiers with a technology type. The technology associated with the FTS tier indicates the tier’s expected performance to the FAST VP controller. This enables you to place the FTS tier at the right location for the expected performance of the external tier.

After configuration, FAST can be set to move/swap data automatically or with user approval. All three drive technologies (EFD, FC, SATA), or external disks (eDisks) are not required in the Symmetrix system to use FAST.

**Note**

On storage systems running Enginuity 5876, FAST is a license-able feature. The Solutions Enabler Array Controls CLI Guide provides additional details about FAST in this storage environment.

**FAST versions**

There are two versions of FAST: FAST for Disk Provisioning (DP) and FAST for Virtual Pools (FAST VP). The following table identifies the differences between the versions:

**Table 3 Comparison of FAST and Fast Virtual Pools (VP)**

<table>
<thead>
<tr>
<th>FAST DP</th>
<th>FAST Virtual Pools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires Enginuity 5876</td>
<td>Requires Enginuity 5876</td>
</tr>
<tr>
<td>Supports standard volumes</td>
<td>Supports thin volumes</td>
</tr>
<tr>
<td>Supports FBA and CKD volume emulation</td>
<td>Supports FBA volume emulation</td>
</tr>
<tr>
<td></td>
<td>Engineuity 5876 supports thin CKD 3390 and thin IBM i 512 volumes</td>
</tr>
<tr>
<td>Disk group provisioning (DP) tiers: contain disk groups</td>
<td>Virtual pool (VP) tiers: contain thin pools</td>
</tr>
<tr>
<td>DP modes: Auto Approve and User Approve</td>
<td>VP modes: Auto Approve or None</td>
</tr>
<tr>
<td>User visible data movement plans and history</td>
<td>No plans or history generated</td>
</tr>
<tr>
<td>Federated Tiered Storage (eDisks) not supported</td>
<td>Supports Federated Tiered Storage (eDisks) with Engineuity 5876 or higher</td>
</tr>
<tr>
<td>Thin volume/thin pool compression not supported</td>
<td>Supports compression for thin volumes and thin (VP) pools</td>
</tr>
<tr>
<td>Up to three tiers per policy supported</td>
<td>Up to four VP tiers per policy with Engineuity 5876.159.102 or higher</td>
</tr>
</tbody>
</table>

**Configuration overview**

The following are the basic steps for configuring FAST in a Symmetrix system:

1. **Creating Symmetrix tiers** on page 177 - A Symmetrix tier is a specification of the type of storage (EFD, FC, SATA, or eDisks) and resources (disk groups/virtual pools) from which storage will be selected. With FAST, from one to four tiers are grouped together into a policy.
2. **Creating FAST policies** on page 182 - A storage group is a group of volumes. When used with FAST, a storage group is associated with a FAST policy and assigned a priority.

3. **Associating FAST policies with storage groups** on page 131 - A FAST policy is a set of one to three DP tiers or one to four VP tiers, but not a combination of both DP and VP tiers. Policies define a limit for each tier in the policy. This limit determines how much data from a storage group associated with the policy is allowed to reside on the tier.

4. A storage group can only be associated with one policy; however, one policy can be associated with multiple storage groups.

The association between a storage group, FAST policy, and Symmetrix tiers is illustrated in the following figure:

![Diagram illustrating the association between a storage group, FAST policy, and Symmetrix tiers](image)

**Managing FAST**
Time windows define when the FAST controller should collect performance information or execute data movement. Time windows are described in Understanding time windows.

Control parameters define the numbers of and types of volumes, the modes of operation, the thresholds for data movement, and the analysis time period. Control parameters are described in .

**Monitoring FAST**
Once you have configured FAST on a storage system, you can use the FAST dashboard to monitor its status, as described in Monitoring FAST (Enginuity 5876) on page 174.

**Monitoring FAST (Enginuity 5876)**

**Before you begin**
- The FAST dashboard is only available for storage systems running Enginuity 5876.
- To refresh the information displayed in the FAST dashboard, click refresh Symmetrix ( ) in the status bar, or exit/return to the FAST dashboard.
The FAST dashboard provides you with a single place from which to examine FAST data, including status and demand reports, and information on policies and storage groups under FAST control. In addition, you can manage the FAST polices on a Symmetrix system.

To access the FAST dashboard:

**Procedure**

1. Select the storage system.
2. Select *Storage* > *FAST*.

The FAST dashboard contains the following components:

**FAST Type**

If the storage system is licensed for both FAST DP and FAST VP, use this option to toggle the monitor between the two features; otherwise, the licensed feature will appear selected for you. The FAST Status Report, FAST Policies, Tiers Demand Report, and Storage Groups Under FAST Control view panels will update according to the feature you select.

**FAST Status Report**

Displays information on the current state of FAST and some of the more important FAST settings, including:

- **Settings**—Opens the FAST Settings dialog box, from which you modify FAST settings. For more information, refer to [Setting FAST control parameters](#) on page 190.
  - **State**—The current state of FAST on the storage system. Possible values are:
    - **Enabled**—The FAST controller is Enabled.
    - **Disabled**—The FAST controller is Disabled.
    - **Disabling**—The FAST controller is transitioning from Enabled to Disabled.
    - **Enabling**—The FAST controller is transitioning from Disabled to Enabled.
    - **Disabled with Error**—The FAST controller is disabled with an error.
    - **Degraded**—The FAST controller is activated but not fully functional because of any of the following reasons: missing DRV volumes or because of some other reason. When degraded, moves are possible; however, static swaps are not.
  - **Data Movement Mode**—The mode in which the FAST controller is operating. Possible values are:
    - **Automatic**—The FAST controller will continuously perform data movement within the time window, without user intervention.
    - **User Approved**—The FAST controller will generate plans, but not perform any movements without user approval. This value only applies to FAST DP.
    - **Off**—The FAST controller will not perform any data movements for thin volumes. This value only applies to FAST VP.
  - **Current Activities**—The current FAST activity. Possible values are:
    - **RunningPlan**—FAST is currently moving or swapping data according to plan.
Idle—FAST is enabled, but not running a plan.

- **Time Windows**
  - **Performance Time Window**—Indicates whether FAST is operating within a defined performance time window. Possible values are:
    - **Closed**—Indicates that FAST is operating within a performance time window.
    - **Open**—Indicates that FAST is operating outside a performance time window (that is, the last performance time window has expired, the next performance time window has yet to start, or there are no performance time windows defined).
  - **Move Time Window**—Indicates whether FAST is operating within a defined move time window. Possible values are:
    - **Closed**—Indicates that FAST is operating within a move time window.
    - **Open**—Indicates that FAST is operating outside a move time window (that is, the last move time window has expired, the next move time window has yet to start, or there are no move time windows defined).

**FAST Policies**

Allows you to view and manage the FAST policies on the Symmetrix system. This view panel includes the following attributes:

- **Manage Policies**—Opens the FAST Policies list view, from which you can manage the FAST Policies on the Symmetrix system.
- **Policy List**—Lists the policies on the Symmetrix system, including the following:
  - **Policy Name**—Name of the policy.
  - **Tier 1**—Symmetrix tier associated with the policy.
  - **Tier 1 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 1.
  - **Tier 2**—Symmetrix tier associated with the policy.
  - **Tier 2 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 2.
  - **Tier 3**—Symmetrix tier associated with the policy.
  - **Tier 3 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 3.
  - **Tier 4**—Symmetrix tier associated with the policy.
  - **Tier 4 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 4.

This view panel displays up to 4 tiers for FAST VP policies and up to 3 tiers for FAST policies.

- **# Associated Storage Groups**—Number of storage groups associated with the policy.

**Tiers Demand Report**

Allows you to view the demand on each tier in the storage system, as either a chart or a table.

The chart format provides the following information for each tier, displayed in Alphabetical or Used order:
• **Used**—The amount of storage that has already been used on the tier, in GB.

• **Free**—The amount of free/unused storage on the tier, in GB.

• **Max SG Demand**—The maximum amount of storage that FAST could put on the tier, in GB.

• **Available to FAST**—The amount of storage available to FAST VP on the tier, in GB. This is the calculated by taking the total enabled capacity for all the pools in the tier (sum of all enabled TDATs) minus the pool reserved capacity (PRC).

The table format provides the same information as the chart format, with the following additions:

• **Tech + Port**—The type of disk on which the tier resides and the tier's RAID protection level.

• **Excess (GB)**—The amount of excess storage available if FAST reaches the maximum of all the percentages in the policies associated with storage groups on the tier, in GB. This value can be either positive or negative. A positive value indicates that there will be enough excess storage available for all the storage groups. A negative value indicates that there will not be enough excess storage available and storage groups will be competing against one another.

Storage Groups Under FAST Control

Allows you to view information on all of the storage groups under FAST control on the Symmetrix system, including:

• **Storage Group Name**—The name of the storage group.

• **FAST Policy**—The FAST Policy associated with the storage group.

• **Capacity Used Break Down Per Tier**—A graphic representation of where the storage group's capacity resides in relation to the tiers in the FAST Policy.

• **Compliant**—Indicates whether the storage group is within compliance. A storage group is compliant if all its volumes exist only on the tiers defined in the policy and the percentage capacity of all tiers it occupies are within the upper limits of the tier capacities specified in the policy. ![indicates compliance.](image) indicates non-compliance.

Symmetrix tiers

**Creating Symmetrix tiers**

**Before you begin**

• This feature requires Enginuity 5876.

• The maximum number of tiers that can be defined on a storage system is 256.

• When a disk group or thin pool is specified, its technology type must match the tier technology.

• Disk groups can only be specified when the tier include type is static.

• A standard tier cannot be created if it will:
  • Lead to a mix of static and dynamic tier definitions in the same technology.
Partially overlap with an existing tier. Two tiers partially overlap when they share only a subset of disk groups. For example, TierA partially overlaps with TierB when TierA contains disk groups 1 & 2 and TierB contains only disk group 2. (Creating TierA will fail.)

To create a Symmetrix tier:

Procedure

1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Click Create Tier to open the Create Tier dialog box.
   When this dialog box first opens, the chart displays the configured and unconfigured space on the selected storage system. Once you select a disk group or thin pool, this chart displays the configured and unconfigured space of the selected object.
4. Type a Tier Name.
   Tier names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore. Each tier name must be unique per Symmetrix system (across both DP and VP tier types), ignoring differences in case.
5. If the Symmetrix system on which you are creating the tier is licensed to perform FAST and FAST VP operations, select a Tier Type.
   Possible values are:
   - DP Tier—A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier's disk technology type and match the tier protection type.
   - VP Tier—A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier's disk technology type and match the tier protection type.
6. If creating a VP tier, select the Emulation type of the thin pools to include in the tier. Only thin pools containing volumes of this emulation type will be eligible for inclusion in the tier.
7. Select the type of Disk Technology on which the tier will reside. Only disk groups or thin pools on this disk technology will be eligible for inclusion in the tier.
8. If you selected External disk technology for the tier, then select the type of External Technology.
9. Select the RAID Protection Level for the tier. Only disk groups or thin pools on this disk technology will be eligible for inclusion in the tier.
10. Depending on the type of tier you are creating, select the disk groups or virtual pools to include in the tier.
11. If creating a DP tier, you can optionally specify to Include all future disk groups on matching technology to this tier. To do this, click Show Advanced, and select the option. Tiers created in this manner are considered dynamic tiers. Tiers created without this option are considered static tiers.
12. Click OK.

Modifying Symmetrix tiers

Before you begin

- This feature requires Enginuity 5876.
- You can only modify tiers that are not part of a policy. For instructions on removing a tier from a policy, refer to Modifying FAST policies.
- You cannot create blank tiers in Unisphere for VMAX (that is, tiers without disk groups or thin pools); however, you can use Unisphere to add disk groups or thin pools to blank tiers that were created in Solutions Enabler.

To modify a Symmetrix tier:

Procedure

1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Select the tier and click Modify to open the Edit Tier dialog box.
4. Add or remove disk groups/thin pools by selecting/clearing the corresponding check box.
5. If you are adding disk groups to a partially overlapped disk group tier (that is, a disk group tier that shares a subset of its disk groups with other disk group tiers) you must use the propagate option. To do this, click Show Advanced, and select Adjust all Diskgroup Tiers (Propagate).
6. Click OK.

Renaming Symmetrix tiers

Before you begin

- This feature requires Enginuity 5876.
- Tier names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens (-), and underscores (_) are allowed, however, the name cannot start with a hyphen or an underscore. Each tier name must be unique per Symmetrix system (across both DP and VP tier types), ignoring differences in case.

Procedure

1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Select the tier and click View Details to open its Details view.
4. Type a new name for the tier.
5. Click Apply.

Deleting Symmetrix tiers

Before you begin

- This feature requires Enginuity 5876.
- You cannot delete tiers that are already part of a policy. To delete such a tier, you must first remove the tier from the policy. For instructions, refer to Modifying FAST policies.

To delete a Symmetrix tier:
Procedure
1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Select the tier and click Delete.
4. Click Delete in the confirmation message.

Viewing Symmetrix tiers

Before you begin
This feature requires Enginuity 5876.

Procedure
1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.

The Tiers list view allows you to view and manage the tiers on a Symmetrix system.
The following properties display:
- Name — Name of the tier.
- Type — Tier type. Possible values are:
  - Disk Group — A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier's disk technology type and match the tier protection type.
  - Virtual Pool — A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier's disk technology type and match the tier protection type.
- Technology — Disk technology on which the tier resides.
- Emulation — Emulation type of the thin pools in the tier.
- Used Capacity — Amount of storage that has already been used on the tier, in GB.
- Capacity (GB) — Amount of free/unused storage on the tier, in GB.
- Protection — RAID protection level assigned to the volumes in the tier.
The following controls are available:
- Create Tier—Creating Symmetrix tiers on page 177
- Modify—Modifying Symmetrix tiers on page 179
- View Details—Viewing Symmetrix tier details on page 180
- Delete—Deleting Symmetrix tiers on page 179

Viewing Symmetrix tier details

Before you begin
This feature requires Enginuity 5876.
Procedure

1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Select the tier and click View Details to open its Details view.

   The tier Details view allows you to view and manage a Symmetrix tier. It contains , , , and panels. There are multiple ways to open this view. Depending on the method used, not all of the following may apply.

Example 1 Properties

The following properties display:

- Name — Name of the tier.
  [OutOfTier]: If on a given technology there exists volumes that do not reside on any tier they will be shown as [OutOfTier]. This can happen when the protection type of volumes does not match the tier protection type, or when tiers are only defined on a subset of disk groups in a technology.

- Is Static — Whether the tier is static (Yes) or dynamic (No). With a dynamic tier, the FAST controller will automatically add all future disk groups on matching disk technology to the tier. Tiers without this option enabled are considered static.

- Type — Tier type. Possible values are:
  - DP — A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier's disk technology type and match the tier protection type.
  - VP — A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier's disk technology type and match the tier protection type.

- Technology — Disk technology on which the tier resides. If Disk Location is External then External Technology property displays and the technology value can be changed.

- RAID Protection — RAID protection level assigned to the volumes in the tier.

- Attribute — Status of the tier on the technology type. Possible values are:
  - Tier in a FAST Policy associated with storage groups.
  - Tier in a FAST Policy unassociated with storage groups.
  - Tier not in any FAST Policy.

- Total Capacity (GB) — Amount of free/unused storage on the tier, in GB.

- Free Capacity (GB) — Unconfigured space in Gigabytes in this tier. Free capacity for each disk group in the tier will only count toward tier free capacity if the disk group has enough usable disks to support the tier target protection type.

- FAST Usage (GB) — Sum of hypers of all volumes in FAST storage group with matching RAID protection that reside on this tier.

- FAST Free (GB) — If the tier is in a FAST policy associated with a storage group, the FAST Free capacity in Gigabytes is the sum of FAST Usage, Free capacity and Space occupied by Not Visible Devices (Unmapped/Unmasked).
Example 1  Properties (continued)

If the tier is not in any FAST policy or in policies where none of the policies are associated to a storage group, then the FAST Available capacity is same as FAST Usage.

- Maximum SG Demand (GB) — The calculated upper limit for the storage group on the tier.
- Excess (GB) — Difference between FAST Free and Max SG Demand. If the tier is not in a FAST policy or in policies where none of the policies are associated to a storage group, then this value is Not applicable.

The following controls are available:

- **Modify**—Modifying Symmetrix tiers on page 179
- **Delete**—Deleting Symmetrix tiers on page 179
- **Apply**—Applies changes made to the tier name.
- **Cancel**—Cancels changes made to the tier name.

Related Objects

The Related Objects panel links you to views displaying objects contained in tier. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Disk Groups- 3** opens a view listing the three disk groups in the policy.

Performance Views panel

The Performance panel links you to the performance monitor and analyze views for the tier.

This panel will display with inactive links if the selected Symmetrix system is not registered for data collection.

Graphs

The Graphs panel provides a graphic representation of the tier's used capacity over free space.

FAST policies

Creating FAST policies

Before you begin

- This feature requires Enginuity 5876.
- The maximum number of policies allowed per storage system is 256.
- Policies must contain either disk group tiers or virtual pool tiers, but not a combination of both disk group and virtual pool tiers.
- Disk group tier policies can contain from one to three tiers.
- Virtual pool tier policies can contain from one to four tiers. Only one out of the four tiers can be an external tier.
- Each tier must be unique and there can be no overlapping disk groups/thin pools.
The first tier added to a policy determines the type of tier the policy will contain.

A policy cannot have an empty tier.

You cannot create blank policies (that is, policies without at least one tier) in Unisphere for VMAX; however, you can create such policies in Solutions Enabler. The *Solutions Enabler Array Controls and Management CLI User Guide* contains instructions on creating blank policies. Unisphere does allow you to manage blank policies.

You cannot add a standard tier to a policy if it will result in a configuration where two tiers share a common disk group.

A FAST policy is a set of one to three DP tiers or one to four VP tiers, but not a combination of both DP and VP tiers. Policies define a limit for each tier in the policy. This limit determines how much data from a storage group associated with the policy is allowed to reside on the tier.

Storage groups are sets of volumes. Storage groups define the volumes used by specific applications. Storage groups are associated with FAST policies, and all of the volumes in the storage group come under FAST control. The FAST controller can move these volumes (or data from the volumes) between tiers in the associated policy.

A storage group associated with a FAST policy may contain standard volumes and thin volumes, but the FAST controller will only act on the volumes that match the type of tier contained in the associated policy. For example, if the policy contains thin tiers, then the FAST controller will only act on the thin volumes in the associated storage group.

**Procedure**

1. Select the storage system.
2. Select *Storage > FAST* to open the FAST dashboard.
3. If the Symmetrix system is licensed for both FAST DP and FAST VP, select the *FAST Type* to which the policy will apply.
4. In the *FAST Policies* view block, click *Manage Policies* to open the FAST Policies details view.
5. Click *Create* to open the Create FAST Policy dialog box.
6. Type a *Policy Name*. Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens (-), and underscores (_) are allowed, however, the name cannot start with a hyphen or an underscore.
7. Select the volume *Emulation*.
8. Select a *Tier* to add to the policy and then specify a storage group capacity for the tier (% MAX of Storage Group). This value is the maximum amount (%) of the associated storage group’s logical capacity that the FAST controller can allocate to the tier. This value must be from 1 to 100. The total capacities for a policy must equal to or be greater than 100.
9. Repeat the previous step for any additional tiers you want to add.
10. Click *OK*.

**Renaming FAST policies**

**Before you begin**

- This feature requires Enginuity 5876.
• Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore.

Procedure
1. Select the storage system.
2. Select Storage > FAST to open the FAST dashboard.
3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies view block, click Manage Policies to open the FAST Policies details view.
5. Select the tier and click View Details to open the policy's Details view.
6. Type a new name for the policy.
7. Click Apply.

Deleting FAST policies

Before you begin
• This feature requires Enginuity 5876.
• You cannot delete a policy that has one or more storage groups associated with it. To delete such a policy, you must first disassociate the policy from the storage groups.

To delete a FAST Policy:

Procedure
1. Select the storage system.
2. Select Storage > FAST to open the FAST dashboard.
3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies view block, click Manage Policies to open the FAST Policies list view.
5. Select the policy and click Delete.
6. Click Delete in the confirmation message.

Associating FAST policies with storage groups

The procedure for associating FAST policies and storage groups, depends on whether you are associating a storage group with a policy or policy with a storage group.

Before you begin
Storage groups and FAST policies can only be associated under the following conditions:
• The VMAX system is running Enginuity 5876.
• The target FAST policy needs to have at least one pool that is part of the source policy in re-association activity.
• The volumes in the new storage group are not already in a storage group associated with a FAST policy.
• The policy has at least one tier.
• The storage group only contains meta heads; meta members are not allowed.
The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:

- CKD EAV
- DRV
- SFS
- iSeries, ICOS, ICL
- SAVE volumes
- VDEVs
- Diskless volumes

The storage group cannot contain a volume that is part of another storage group already associated with another policy.

The storage system has fewer than the maximum number of allowed associations (8,192).

To associate a FAST policy with a storage group:

**Procedure**

1. Select the storage system.
2. Select Storage > FAST.
3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies panel, click Manage Policies.
5. Select the policy and click Associate Storage Groups to open the Associate Storage Groups dialog box.
6. Select one or more storage groups, and then click either of the following:
   - **OK** to associate the storage group.
   - **Show Advanced** to continue setting the advanced options.
     a. To have FAST factor the R1 volume statistics into move decisions made for the R2 volume, select Enable FAST [VP|DP] RDF Coordination. This attribute can be set on a storage group, even when there are no SRDF volumes in the storage group. This feature is only available if the storage system is part of an SRDF setup. Both R1 volumes and R2 volumes need to be running Enginuity version 5876 or higher for the FAST VP system to coordinate the moves. However, the setting of the RDF coordination attribute will not be prevented if one of the Symmetrix systems is running an Enginuity level lower than 5876.
     b. Click OK.

**Associating storage groups with FAST policies**

**Before you begin**

Storage groups and FAST policies can only be associated under the following conditions:

- The VMAX system is running Enginuity 5876.
- The target FAST policy needs to have a least one pool that is part of the source policy in re-association activity.
The volumes in the new storage group are not already in a storage group associated with a FAST policy.

The policy has at least one tier.

The storage group only contains meta heads; meta members are not allowed.

The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:

- CKD EAV
- DRV
- SFS
- iSeries, ICOS, ICL
- SAVE volumes
- VDEVs
- Diskless volumes

The storage group cannot contain a volume that is part of another storage group already associated with another policy.

The storage system has fewer than the maximum number of allowed associations (8,192).

To associate a storage group with a FAST policy:

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select the storage group, click more, and select Associate to FAST to open the Associate to FAST Policy dialog box.
4. Select a policy and click OK.

**Disassociating FAST policies and storage groups**

**Procedure**

1. Select the storage system.
2. In the navigation bar, click Storage to open the Storage section.
3. Click FAST to open the FAST dashboard.
4. Select the FAST Type.
5. In the FAST Policies view block, click Manage Policies to open the FAST Policies details view.
6. Select the policy and click View Details to open the policy's details view.
7. In the Related Object view panel, click Storage Groups - nn to open the Storage Groups for FAST Policy details view.
8. Select the one or more storage groups and click Disassociate.
9. Click OK.
Reassociating FAST polices and storage groups

Before you begin

- This feature requires Enginuity 5876.
- The storage group name must be valid.
- The storage group and policy must already exist on the storage system.
- The storage group must be in an association before performing a reassociation.
- The new policy for the storage group, must have the same emulation as the storage group. Mix emulation association will result in an error.
- The storage group cannot be associated with an empty policy, and the reassigned policy must contain at least one tier.
- The total of the capacity percentage for the target FAST policy must add up to at least 100%.
- If the FAST policy contains VP Tiers, all of the thin devices in the storage group must be bound to any VP pool in a tier in the policy. None of the thin devices can be bound to a pool outside of the policy.

This procedure explains how to reassociate a storage group with a new policy. When reassociating a storage group, all the current attributes set on the original association automatically propagate to the new association. This feature eliminates the previous process of disassociating a storage group, then associating the group to a new policy, and entering the attributes, such as priority, on the association.

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups list view.
3. Select the storage group, click more button, and click Reassociate to FAST Policy to open the Reassociate to FAST Policy dialog box.
4. Select a policy and click OK.

Viewing FAST policies

Before you begin

This feature requires Enginuity 5876.

Procedure

1. Select the storage system.
2. Select Storage > FAST to open the FAST dashboard.
3. If the Symmetrix system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies view block, click Manage Policies to open the FAST Policies list view.

Use the FAST Policies list view to view and manage FAST policies on a Symmetrix system.

The following properties display:

- Policy Name—Name of the policy.
- Tier 1—Symmetrix tier associated with the policy.
• **Tier 1 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 1.

• **Tier 2**—Symmetrix tier associated with the policy.

• **Tier 2 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 2.

• **Tier 3**—Symmetrix tier associated with the policy.

• **Tier 3 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 3.

• **Tier 4**—Symmetrix tier associated with the policy.

• **Tier 4 %**—Maximum amount (%) of an associated storage group that can be allocated to the Symmetrix tier 4.

• **# Associated Storage Groups**—Storage group associated with the policy.

The following controls are available:

• **Create**—Creating FAST policies on page 182

• **View Details**—Viewing FAST policy details on page 189

• **Delete**—Deleting FAST policies on page 184

• **Associate Storage Groups**—Associating storage groups with FAST policies on page 133

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**Viewing storage group for FAST policies**

**Procedure**

1. Select the storage system.
2. Select **Storage > FAST** to open the FAST dashboard.
3. If the storage system is licensed for both FAST DP and FAST VP, select the **FAST Type**.
4. In the **FAST Policies** view block, click **Manage Policies** to open the **FAST Policies** list view.
5. Select the policy and click **View Details** to open its **Details** view.
6. In the **Related Object** panel, click **Storage Groups** to open the **Storage Groups for FAST Policy** list view.

Use the **Storage Groups for FAST Policy** list view to view and manage the storage groups in a FAST Policy.

The following properties display:

• **Name**—Name of the storage group.

• **FAST Policy**—Policy associated with the storage group.

• **Capacity**—Total capacity of the storage group in GB.

• **Volumes**—Number of volumes contained in the storage group.

• **Masking Views**—Number of masking views associated with the storage group.

The following controls are available:
Viewing FAST policy details

Before you begin
This feature requires Enginuity 5876.

Procedure
1. Select the storage system.
2. Select Storage > FAST to open the FAST dashboard.
3. If the Symmetrix system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Policies view block, click Manage Policies to open the FAST Policies list view.
5. Select the policy and click View Details to open its Details view.

The policy Details view allows you to view and manage a FAST Policy. It contains Properties, Related Objects, Performance Views, and Graphs panels.

Properties panel
The following properties display:
- Policy Name — Name of the policy. To rename the policy, type a new name over the existing and click Apply. Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore.
- Tier 1 - 3 (for FAST DP)
- Tier 1 - 4 (for FAST VP) — Symmetrix tier associated with the policy, followed by the maximum amount (%) of the associated storage group's logical capacity that the FAST controller can allocate to the tier. This value must be from 1 to 100. The total capacities for a policy must be greater than or equal to 100. To change a tier, select another from the list, and click Apply. To change a maximum amount, type a new amount, and click Apply.

The following controls are available:
- Associate Storage Groups—Associating storage groups with FAST policies on page 133
- Delete—Deleting storage groups on page 136
- Apply—Applies changes made in the Properties list. For example, renaming the policy.
- Cancel—Cancels changes made in the Properties list.

Related Objects panel
The Related Objects panel links you to views displaying objects contained in and associated with the FAST Policy. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Tiers - 3 will open a view listing the three tiers in the policy.
Performance Views panel
The Performance panel links you to the performance monitor and analyze views for the policy.
This panel will display with inactive links if the selected Symmetrix system is not registered for data collection.

Graphs panel
The Graphs panel includes graphic representations of the used and free space available for each tier in the policy. In addition, each chart includes markers for the following metrics:

- Max SG Demand — The calculated upper limit for the storage group on the tier.
- Available to FAST — The amount of storage available for FAST operations on the tier.

FAST controller

Setting FAST control parameters

Before you begin
This feature requires Enginuity 5876.

Procedure
1. Select the storage system.
2. Select Storage > FAST to open the FAST dashboard.
3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type.
4. In the FAST Status Report view block, click Settings to open the corresponding FAST [VP|DP] Settings dialog box.
5. Modify any number of the parameters and click OK.
Refer to FAST control parameters on page 190. Note that the parameters available to you depend on the version of FAST.

FAST control parameters

Table 4 Comparison of FAST DP and Fast VP

<table>
<thead>
<tr>
<th>FAST DP</th>
<th>FAST VP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set State</strong> — Enables/Disables the FAST controller. When Enabled, the FAST controller will move data between tiers based on the defined policies. When Disabled, the FAST controller will not move data between tiers. By default, the FAST controller is disabled.</td>
<td></td>
</tr>
<tr>
<td><strong>Data Movement Mode</strong> — Sets the mode of the FAST controller to automatic or user approval mode. If the FAST controller is set to user approval mode, it will generate plans, but not perform any movements unless the plans are approved by the user. This option is shared with Symmetrix Optimizer.</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Moves Per Day (2-200)</strong> — Specifies the maximum number of moves to perform in a 24 hour period, starting at 12:00</td>
<td></td>
</tr>
<tr>
<td><strong>Relocation Rate (1-10)</strong> — Specifies the data movement mode for thin volumes. If set to Automatic, the FAST system will</td>
<td></td>
</tr>
</tbody>
</table>
Table 4 Comparison of FAST DP and Fast VP (continued)

<table>
<thead>
<tr>
<th>FAST DP</th>
<th>FAST VP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM. Possible values range from 2 to 200, with 200 being the default. This option is shared with Symmetrix Optimizer.</td>
<td>continuously perform data movement for thin volumes within the data movement window, without user intervention. If set to Off, the FAST controller will not perform any data movement for thin volumes. There is no equivalent to user approval mode for thin data movement.</td>
</tr>
<tr>
<td><strong>Maximum Simultaneous Moves (2-32)</strong> — Specifies the maximum number of moves that can be performed at one time. Possible values range from 2 to 32, with 32 being the default. This option is shared with Symmetrix Optimizer.</td>
<td><strong>Pool Reserved Capacity (1-80)</strong> — Specifies the capacity of each thin pool (percentage) that will be reserved for non-FAST activities. If the free space in a given thin pool (as a percentage of pool-enabled capacity) falls below this value, the FAST controller will not move any more chunks (a group of 12 tracks) into that pool. To move any new chunks to the pool, the FAST controller must first move some chunks from that pool to another pool to free up space. Enforcement of this parameter is best-effort; FAST may move chunks to a thin pool resulting in a violation because non-FAST activities (such as new allocations for writes to a thin volume) can simultaneously consume pool free capacity. Possible values range from 1 to 80, with 10 being the default.</td>
</tr>
<tr>
<td><strong>Migration Restriction</strong> — Specifies whether the FAST controller can perform swaps and moves, or only swaps.</td>
<td><strong>Allocate by FAST Policy</strong> — When enabled, the system chooses a pool for the policy when making an allocation for a thin volume.</td>
</tr>
<tr>
<td><strong>Allow FAST to use volumes that are not visible to the host for full swaps</strong> — Indicates if the FAST controller can use host invisible volumes (unmasked and unmapped) to do a full swap with volumes in storage groups under FAST control to improve the performance of the storage group. Possible values are ENABLE and DISABLE. The default is DISABLE.</td>
<td><strong>Compression Attributes</strong> — Enables FAST VP Compression. When enabled, the FAST controller will compress the members of any thin pool (for which this feature is enabled) according to the following attributes:</td>
</tr>
<tr>
<td></td>
<td>• <strong>Time to Compress (40-400)</strong> — Specifies how frequently compression will occur. Valid values are 1 - 365 days. Default is 40 days.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Compression Rate (1-10)</strong> — Specifies the compression rate. Valid values are 1 (most aggressive to 10 (least aggressive). Default is 5.</td>
</tr>
<tr>
<td></td>
<td>You can enable this feature for a thin pool while creating it (Creating thin pools or post creation in the pool’s Details view (Viewing thin pool details on page 306). In addition, you can also manually control this feature at the storage group level (Managing...</td>
</tr>
</tbody>
</table>
Table 4 Comparison of FAST DP and Fast VP (continued)

<table>
<thead>
<tr>
<th>FAST DP</th>
<th>FAST VP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VP compression on storage groups on page 138.</td>
</tr>
</tbody>
</table>

Pinning and unpinning volumes

Before you begin

This feature requires Enginuity 5876.

Pinning volumes prevents any automated process such as FAST or Optimizer from moving them. However, you can still can manually move a pinned volume with Optimizer or migrate a pinned volume with Virtual LUN Migration.

Note

The capacity of pinned volumes is counted for compliance purposes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes dashboard.
3. Select the volume type in tree menu and click View to open its list view.
4. Select one or more volumes, click more, and select one of the following:
   - Pin — To pin the volumes.
   - Unpin — To unpin the volumes.
5. Click OK.

Time windows

Understanding time windows

Time windows are used by FAST, FAST VP, and Symmetrix Optimizer to specify when data can be collected for performance analysis and when moves/swaps can execute.

There are two types of time windows:

- **Performance time windows** — Specify when performance samples can be taken for analysis.
- **Move time windows** — Specify when moves/swaps are allowed to start or not start.

In addition, performance and move time windows can be further defined as open or closed:

- **Open** — When creating performance time windows, this specifies that the data collected in the time window should be included in the analysis. When creating move time windows, this specifies that the moves can start within the time window. This type of time window is also referred to as inclusive.
- **Closed** — When creating performance time windows, this specifies that the data collected in the time window should be excluded from analysis. When creating
move time windows, this specifies that the moves cannot start within the time window. This type of time window is also referred to as exclusive.

Creating and modifying time windows
This procedure explains how to create/modify time windows.

Before you begin
- This feature requires Enginuity 5876.
- Time windows are used by FAST and Optimizer. Changes made to FAST time windows may also affect Optimizer.
- The maximum number of time windows that can be defined on a storage system is 128.

Procedure
1. To create time windows:
   1. Select the storage system.
   2. Select Storage > FAST to open the FAST dashboard.
   3. If the storage system is licensed for both FAST DP and FAST VP, select the FAST Type to which the time window will apply.
   4. In the FAST Status Report view block, click the type of time window you want to create or modify.
      Depending on your selection, either the Performance Time Window or the Move Time Window dialog opens.
   5. In the Show field, click the calendar icon and select the week in which to define the time window.
   6. Click Show Advanced.
   7. If you are creating or modifying an open time window do the following:
      a. Click Manage next to the Open Time Windows (Inclusive) option to open the Manage Open Performance Time Window dialog.
      b. Define the time window, by selecting one of the following options and clicking Add:
         - **Always open** — Creates a single open time window for the entire week (Sunday to Saturday).
         - **All weekend** (Fri:18:00 - Mon:00:00) — Creates a single open time window for the weekend (17:00 Friday to 8:00 Monday).
         - **9:00-17:00, Monday-Friday** — Creates five time windows, one for each day of the work week.
         - **17:00-8:00, Monday-Friday** — Creates five time windows, one for each of night of the work week.
         - **Custom** — Allows you to define your own time window.
      c. Click OK to close the Manage dialog box.

Alternatively, if you are creating or modifying a closed time window, do the following:
a. Click **Manage** next to the **Closed Time Windows (Exclusive)** option to open the **Manage Closed Performance Time Windows** dialog.

b. Define the time window, by selecting a **Start Date/Time** and an **End Date/Time**, and clicking **Add**.

c. Click **OK** to close the **Manage** dialog box.

8. Define the following parameters:

   - **Workload Analysis Period** — Specifies the amount of workload sampling to maintain for sample analysis. Possible values are specified in units of time (hours, days, or weeks) and can range from 2 hours to 4 weeks, with the default being one week.

   - **Time to Sample before First Analysis** — Specifies the minimum amount of workload sampling to complete before analyzing the samples for the first time. When setting this parameter, be sure to allow enough time (usually a week) to establish a good characterization of the typical workload. This parameter allows you to begin operations before the entire Workload period has elapsed. Possible values range from 2 hours to the value specified for the **Workload Analysis Period** parameter, with the default being eight hours.

9. Click **OK**.

**Deleting time windows**

This procedure explains how to delete time windows.

**Before you begin**

Time windows are used by FAST and Optimizer. Changes made to FAST time windows may also affect Optimizer.

**Procedure**

1. To delete time windows:
   1. Select the storage system.
   2. Select **Storage > FAST** to open the FAST dashboard.
   3. If the storage system is licensed for both FAST DP and FAST VP, select the **FAST Type** to which the time window applies.
   4. In the **FAST Status Report** view block, click **Edit** next to the type of time window you want to delete.

   Depending on your selection, either the **FAST Performance Time** window or **Move Time** window dialog box opens.

5. In the **Show** field, click the calendar icon and select the week in which to delete the time window.

6. Click **Show Advanced**.

7. Click **Manage** next to the type of time window you are deleting (open or closed) to open the corresponding **Manage** dialog.

8. Select the existing time window and click **Delete**.

9. Click **OK**.

**FAST Movement Time Window dialog box**

Use this dialog box to manage movement time windows, including the following tasks:
Creating and modifying time windows on page 193
Deleting time windows on page 194

FAST Performance Time Window dialog box
Use this dialog box to manage performance time windows, including the following tasks:
- Creating and modifying time windows on page 193
- Deleting time windows on page 194

Manage Closed Movement Time Windows dialog box
Use this dialog box to manage closed movement time windows, including the following tasks:
- Creating and modifying time windows on page 193
- Deleting time windows on page 194

Manage Closed Performance Time Windows dialog box
Use this dialog box to manage closed movement time windows, including the following tasks:
- Creating and modifying time windows on page 193
- Deleting time windows on page 194

Manage Open Movement Time Windows dialog box
Use this dialog box to manage open movement time windows, including the following tasks:
- Creating and modifying time windows on page 193
- Deleting time windows on page 194

Manage Open Performance Time Windows dialog box
Use this dialog box to manage open performance time windows, including the following tasks:
- Creating and modifying time windows on page 193
- Deleting time windows on page 194

Understanding Workload Planner
Workload Planner is a FAST component used to display performance metrics for applications and to model the impact of migrating the workload from one storage system to another.

Workload Planner is supported on storage systems running Enginuity 5876 or HYPERMAX OS 5977.

For storage groups to be eligible for Workload Planning, they must meet the following criteria:
- On a locally attached storage system registered for performance. See Registering storage systems on page 688 for instructions on registered storage systems.
- Belong to only one masking view.
Under FAST control:
- For storage systems running HYPERMAX OS 5977, they must be associated with a service level.
- For storage systems running Enginuity 5876, they must be associated with a FAST policy.
- Contain only FBA volumes.

In addition, the Unisphere for VMAX server must be on an open systems host.

Viewing storage group workload (HYPERMAX OS 5977 or higher)

**Before you begin**
- To perform this operation, a Monitor role is required.
- The storage system must be local and registered for performance.

This procedure explains how to view the statistics used to compute the service level compliance of a storage group.

**Procedure**
1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
4. Select the storage group and click **View details** to open its details view.
5. If not already displaying, click the **Compliance** tab.

   The **Workload** tab allows you to view workload details, organized into the following panels:
   - **Service Level**
     - The service level associated with workload (Storage Group).
   - **Service Level Compliance**
     - The calculated compliance of the workload as measured against its service level.
   - **Capacity Trend**
     - The percentage of change in the storage group capacity over the previous two weeks.
   - **Performance**
     - Links you to the performance **Analyze** and **Monitor** views for the storage group.
     - This panel will display with inactive links if the selected VMAX system is not registered for data collection.
   - **Weighted Averages**
     - Displays the following charts:
       - **Response Time (ms)**—Displays the calculated weighted average response time in milliseconds for the storage group over the previous 4 hours and 2 weeks, against the service level value range for the storage group.
       - **IOs per Sec**—Displays the calculated weighted average IOs/second for the storage group over the previous 4 hours and 2 weeks.
     - **CPU/Port Load Scores**
Displays the following charts:

- **% Front end** — Displays the calculated IO load scores of the storage group's front-end CPUs and ports as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.
- **% Back end** — Displays the calculated IO load scores of the storage group's back-end CPUs and ports as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.
Note

You can optionally toggle the format used to display the load scores between IOs/sec and MB/sec.

Access Density Skew Scores

Displays the load scores for the storage group in the following charts:

- **% High Load** — Displays the calculated skew density score for the high load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

- **% Mixed Load** — Displays the calculated skew density score for the mixed load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

- **% Low Load** — Displays the calculated skew density score for the low load disks in the storage group as a percentage of the storage group's expected values. The scores are calculated for the previous 4 hours and 2 weeks.

You can toggle the format used to display the load scores between the following views:

- **IOs/sec** — Displays the calculated skew scores for the storage group in IOs per second.

- **MB/sec** — Displays the calculated skew scores for the storage group in megabytes per second.

- **GB** — Displays the calculated skew scores for total data throughput (in GB) for the storage group.

In general, the **High load** and **Low load** numbers should be between 25 and 175 and the **Mixed load** number should be between 50 and 150.

Higher skew storage groups should display the following characteristics for load (IOs/sec) and Capacity:

- **IOs/sec** — Higher High load numbers and lower Low load numbers.

- **Capacity** — Higher Low load numbers and lower High load numbers.

Lower skew storage groups should display higher **Mixed load** numbers and lower **High load** and **Low load** numbers for load (IOs/sec) and Capacity.

When displaying load (IOs/sec):

- Higher **High load** numbers indicate that it is easier for the system to provide lower than expected response time for the storage group.

- Higher **Low load** numbers indicate that it is more difficult for the system to keep the storage group away from SATA storage.

When displaying Capacity:

- Lower **High load** numbers indicate that the storage group can have low response times while using less than expected amounts of Flash storage.

- Lower **Low load** numbers indicate that the storage group cannot take advantage of SATA storage.

The following controls are available if the storage system is running HYPERMAX OS 5977 or higher:

- **Save as Reference Workload** — Creating Reference Workloads on page 106

- **Reset Workload Plan** — Resetting Workload Plan on page 199
Resetting Workload Plan

Before you begin
To perform this operation, a StorageAdmin role is required.
Resetting the workload plan requires one week of data.
This procedure explains how to set the performance baseline expectations of a storage group to the characteristics currently measured for the previous two weeks.

Procedure
1. Select the storage system.
2. Do the following depending on the storage operating environment:
   - For HYPERMAX OS 5977 or higher:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.
3. Select the storage group and click View details to open its details view.
4. If not already displaying, click the Compliance tab.
5. Click Reset Workload Plan.
6. Review the Current Scores and the projected New Baseline.
7. If satisfied, click OK.

Results
Once complete, the Workload Planning tab updates with the newly calculated performance metrics.

Analyzing FAST migration
The FAST Array Advisor wizard determines the performance impact of migrating the workload from one storage system (source) to another storage system (target). If the wizard determines that the target storage system can absorb the added workload, it automatically creates all the necessary auto-provisioning groups to duplicate the source workload on the target storage system.

Before you begin
- Performing the analysis portion of the procedure requires a Monitor role.
- Performing the migration preparation steps requires a StorageAdmin role.
- The following migrations are supported:

<table>
<thead>
<tr>
<th>Source storage system</th>
<th>Target storage system</th>
</tr>
</thead>
</table>
| Enginuity 5876             | • Enginuity 5876 or HYPERMAX OS 5977 or higher
|                            | • Target storage systems running Enginuity 5876 must have at least one thin pool. |
| HYPERMAX OS 5977 or higher | HYPERMAX OS 5977 or higher                                |
The source storage system must be local and registered for Performance. Registering storage systems on page 688 explains how to register storage systems.

The storage group must:

- Not be a child storage group. Only standalone or parent storage groups can be selected for analysis. If a parent storage group is selected, its child storage groups will be implicitly selected as well, and the analysis will apply to the entire collection of parent and child storage groups as a group.
- Not have ongoing Workload Planning processing.
- Be associated with a single masking view.
- Only contain FBA volumes. It cannot be empty or contain only gatekeeper volumes.
- Be associated with a service level (HYPERMAX OS 5977) or associated with a FAST policy (Enginuity 5876).

Procedure

1. Select the storage system.
2. Select the storage group, click , and select FAST Array Advisor to open the FAST Array Advisor wizard.
3. Do the following, depending on the storage operating environment:
   - For HYPERMAX OS 5977 or later:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Storage Groups panel, click Total to open the Storage Groups list view.

   **Note**

   In eNAS operating environments, you can also perform this operation from Storage Groups for File page (System > System Dashboard > File Dashboard > File Storage Groups).

   - For Enginuity 5876:
     Select Storage > Storage Groups to open the Storage Group list view.
4. Select the Target storage system to include in the analysis, or select All available arrays to include all available storage systems in the analysis.
5. Do the following, depending on your target storage system selection:
   - For target storage systems running HYPERMAX OS 5977 or higher:
     a. Select the Storage Resource Pool (SRP) to associate with the storage group.
     b. Select the Service Level to associate with the storage group. If the storage group is a parent, this involves selecting service levels for each of the child storage groups.
     c. Click Next.
     d. Select the target storage system port configuration parameters to include in the analysis, including:
- The **Number of ports** to use for the migrated storage group.
- Whether to allow the system to select the most suitable ports (All available ports), or to select **Specific ports**. Selecting the latter will display the list of ports from which you can select. The port list includes the port identifier and whether the VSA bit is enabled (Enabled is indicated with a flag).

e. Click **Next**.

- For target storage systems running Enginuity 5876:
  a. Select the FAST policy to associate with the storage group. If the storage group is a parent, this involves selecting policies for each of the child storage groups.
  b. Click **Next**.
  c. Select the target storage system port configuration parameters to include in the analysis, including:
     - The **Number of ports** to use for the migrated storage group.
     - Whether to allow the system to select the most suitable ports (All available ports), or to select **Specific ports**. Selecting the latter will display list of ports from which you can select. The port list includes the port identifier and whether the VSA bit is enabled (Enabled is indicated with a flag).
  d. Click **Next**.

- For all available ports:
  Click **Next**.

6. Determine the suitability of the migration. If the purposed migration is suitable, click **Next**; otherwise, click **Back** to configure another possible migration.

---

**Note**

This option is only available under certain circumstances. For more information, refer to **Suitability Check restrictions** on page 104.

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- ✓ indicates a suitable migration
- ✗ indicates a non-suitable migration.

In both cases, results are displayed in a bar chart by component (Front End, Back End, Cache) along with a score from 0 to 100 indicating the components expected availability on the target storage system after a potential migration.

The current score for the component is shown in gray, with the additional load for the component shown in green or red indicating suitability. The additional score is red if the current and additional loads total more than 100.

7. Prepare for the migration by reviewing the objects that will be created on the target storage system:
Note
Each object will be named exactly as it is on the source storage system. In the case of naming conflicts, a numeric suffix will be appended to target name to guarantee uniqueness. If the resulting suffixed name is longer than the 64 character limit, the target name will be truncated and the suffix added to the shortened name.

Masking View
Name of the masking view.

Storage Group
Any host I/O limits set on the source storage group will be copied to the target storage group.

Storage Group
Name of the storage group. If the storage group is a parent, you can expand the entry to view its child storage groups.

Volumes
Number of volumes to be created on the target storage system.

Capacity (GB)
Capacity of the storage group.

Port Group
Port Group
Name of the port group.

Port
Name of the ports to be included in the port group.

Initiator Group
Initiator Group
Name of the initiator group. If the initiator group is a parent, you can expand the entry to view its child initiator groups.

Initiator
Name of an initiator to be included in the initiator group.

The initiator group created on the target storage system will be an exact copy of the source workload's associated initiator group, including all initiators, child initiator group relationships, and flags. If this target cannot be created exactly as the source, then an error message will return.

XML File
Displays the name of the XML file that will be created on the Unisphere for VMAX server to store information for the migration. The XML file name uses the form:

target_storage_system_id_target_sg_name
8. Click Finish.

This creates all the necessary auto-provisioning groups to duplicate the source workload on the target storage system. This may take some time to complete. The process has multiple steps, marked with a dialog box indicating the success or failure of each.

Note

Should the process fail, any partially created objects will remain on the target storage system until manually removed.

Viewing thin pools in a Symmetrix tier

Procedure

1. Select the storage system.
2. Select Storage > Tiers to open the Tiers list view.
3. Select the tier and click View Details to open its Details view.
4. In the Related Objects panel, click Thin Pools to open the tier’s Thin Pool view.

This view allows you to view and manage a tier’s thin pool. The following properties display:

- **Name**—Pool name.
- **Technology**—Disk technology type.
- **Configuration**—Protection configuration.
- **Emulation**—Pool emulation type based on the first volume added to the pool.
- **Allocated Capacity**—Percent capacity allocated to the pool.
- **Capacity (GB)**—Pool capacity in Gigabytes.

The following controls are available:

- **Create**—Creating thin pools on page 296
- **Expand**—Expanding thin pools on page 297
- **View Details**—Viewing thin pool details on page 306
- **Delete**—Deleting thin pools on page 299

Managing volumes (HYPERMAX OS 5977 or higher)

For storage systems running HYPERMAX OS 5977 or higher, the Volumes view provides you with a single place from which to view and manage all the volumes types on the system.

Note

For instructions on managing volumes on storage systems running Enginuity versions 5773 or 5876, refer to Managing volumes (Enginuity 5773 or 5876) on page 204.

To use the Volumes view:
Procedure

1. Select the storage system.

2. Select Storage > Volumes to open the Volumes list view.
   By default, the view opens displaying thin volumes.

3. Optional: Filter the volume list by doing the following:
   a. Selecting/typing values for any number of the following criteria:
      • Volume Configuration—Filters the list for volumes with a specific configuration.
      • Model—Valid for CKD-3390 emulation only.
      • Capacity equal to—Filters the list for volumes with a specific capacity.
      • Volume ID—Filters the list for a volume with:
         ▪ A specific ID, for example, 001.
         ▪ A range of IDs, for example, 001-0FF.
         ▪ A list of IDs and/or ranges, for example, 001, 003-07F.
      • Volume Identifier Name—Filters the list for the specified volume name.

   b. Click Find to run the query now, or refine your query with conditional expressions, as described next.

   c. In the Additional Criteria section, select values for the following, and then click Add Another. Repeat this step for each additional expression.
      • Category—Specifies the broad category.
      • Attribute—Refines the category.
      • Is equal to—Establishes the relationship between the attribute and the value.
      • Value—Conditions for the specified attribute.

   d. Click Find to filter the volume list.

   For field and control descriptions, refer to the following volume-specific help pages:
      • TDEV—Viewing thin volumes on page 273
      • DATA—Viewing DATA volumes on page 292
      • CKD—Viewing CKD volumes on page 229

Managing volumes (Enginuity 5773 or 5876)

For storage systems running Enginuity versions 5773 or 5876, the Volumes Dashboard provides a high-level view of all volumes on a storage system and a breakdown of the volume types.

Note

For instructions on managing volumes on storage systems running HYPERMAX OS 5977, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203.
To use the Volumes view:

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
   This dashboard contains two panels, All Volumes and Volumes Distribution Chart.
3. Expand the tree menu in the All Volumes panel to view the types/number of volumes on the storage system.
4. Double-click a volume type to open its list view, from which you can view details and perform operations on specific volumes.

All Volumes panel
The following properties display (Click a column heading to sort the list by that value):

- **General Volume Types**—High level volume container types such as, Regular, Virtual, Meta, Private.
- **Volume Type**—Name of volume type container.
- **Number of Volumes**—Number of volumes in the container.

The following controls are available:

- **Emulation**—Filters the listed volumes by emulation type (ALL, FBA, CKD). This filter only appears when there are multiple emulations types available.
- **View**—Allows for viewing the various volume container types.

Volumes Distribution Chart
The Volumes Distribution Chart provides a pie chart representation of volume type percentages of the total volumes and the count for each volume type.

Creating volumes

This procedure explains how to create volumes.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. Do the following, depending on the storage operating environment and the type of volumes you are creating:
Creating DATA volumes

This procedure explains how to create DATA volumes on storage systems running Enginuity version 5773 or 5876.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In Volume Type, click Private.
4. Select DATA as the Configuration.
5. Select the Disk Technology.

   External disk technology is an option if the storage system has FTS (Federated Tiered Storage) enabled and available external storage.

6. Select the Emulation type.
7. Select the RAID Protection level.
8. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
9. To add the new volumes to a specific thin pool, select one from Add to Pool. Pools listed are filtered on technology, emulation, and protection type.
10. Do one of the following:
    - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
    - Expand Add to Job List, and click Run Now to perform the operation now.
Click **Show Advanced** to continue setting the advanced options, as described next.

The advanced options presented depend on the value selected for **Add to Pool**. Complete any of the following steps that are appropriate:

- Select the **Disk Group** (number and name) in which to create the volumes. The list of disk groups is already filtered based on the technology type selected above.
- To enable the new volumes in the pool, select **Enable volume in pool**.
- To rebalance allocated capacity across all the DATA volumes in the pool, select **Start Write Balancing**.

Do either of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Creating diskless volumes

This procedure explains how to create diskless volumes on storage systems running Enginuity version 5773 or 5876.

**Procedure**

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes** under **Common Tasks** to open the **Create Volume** dialog box.
3. In **Volume Type**, click **Virtual**.
4. Select **DLDEV** as the **Configuration**.
5. Select the **Emulation** type.
6. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter the volume capacity.
7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

#### Setting advanced options

- To assign **Dynamic Capability** to the volumes, select one of the following. Otherwise, leave this field set to None.
  - **RDF1_Capable** — Creates a dynamic R1 RDF volume.
  - **RDF2_Capable** — Creates a dynamic R2 RDF volume.
  - **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

The **Define Meta** panel only displays when attempting to create a volume larger than the value specified in the Minimum Auto Meta Size.
b. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:
   - **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
   - **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

c. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Creating DRV volumes

This procedure explains how to create DRV volumes on Symmetrix systems running Enginuity version 5773 or 5876.

**Procedure**

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes** under **Common Tasks** to open the **Create Volume** dialog box.
3. In **Volume Type**, click **Private**.
4. From **Configuration**, select **DRV**.
5. Select the **Disk Technology** on which to create the volumes.
6. Select the **Emulation** type.
7. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
8. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

Setting Advanced options:

a. To create the volumes from a specific disk group, select one (disk group number and name) from **Disk Group**.
   If Auto meta is enabled on the system then it displays as enabled with a green check mark.

b. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
Creating gatekeeper volumes

This procedure explains how to create gatekeeper volumes on storage systems running Enginuity version 5773 or 5876.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. To create a gatekeeper, complete the following steps:
   4. In Volume Type, click Regular.
   5. Select Gatekeeper as the Configuration.
   6. To create a virtual gatekeeper, complete the following steps:
      7. In Volume Type, click Virtual.
      8. Select Virtual Gatekeeper as the Configuration.
      9. Select the Emulation type.
   10. Type the Number of Volumes to create.
   11. If creating virtual gatekeepers, you can optionally bind them to a specific thin pool (Bind to Pool). Only thin pools with enabled DATA volumes and matching emulation are available for binding (except AS/400 which will bind to an FBA pool).
   12. Do one of the following:
      • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
      • Expand Add to Job List, and click Run Now to perform the operation now.

Creating regular volumes

This procedure explains how to create regular volumes on storage systems running Enginuity version 5773 or 5876.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In the Volume Type panel, click Regular.
4. Select the Configuration.
5. Select the Disk Technology.
   External disk technology is an option if the storage system has FTS (Federated Tiered Storage) enabled and available external storage.
6. Select the Emulation type.
7. Select the RAID Protection level.
8. Specify the capacity to create by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
9. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
- Click **Show Advanced** to continue setting the advanced options, as described next.

**Setting Advanced options:**

a. **z/OS Only**: Type the **SSID** for the new volume, or click **Select...** to open a dialog from which you can select an SSID. This is required for volumes on storage systems with ESCON or FICON directors (or mixed systems). This field is optional on storage systems running Enginuity 5773 or higher when reducing the number of mirrors.

b. To create the volumes from a specific **Disk Group**, select one (disk group number and name).

c. To name the new volumes, select one of the following **Volume Identifiers** and type a **Name**:
   - **None** — Allows the system to name the volumes (Default).
   - **Name Only** — All volumes will have the same name.
   - **Name + VolumeID** — All volumes will have the same name with a unique storage system volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
   - **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to **Setting volume names** on page 226.

d. To assign **Dynamic Capability** to the volumes, select one of the following; otherwise, leave this field set to **None**.
   - **RDF1_Capable** — Creates a dynamic R1 RDF volume.
   - **RDF2_Capable** — Creates a dynamic R2 RDF volume.
   - **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:
   - **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
   - **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

f. Do either of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more
Creating SAVE volumes

This procedure explains how to create SAVE volumes on Symmetrix systems running Enginuity version 5773 or 5876.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In Volume Type, click Private.
4. From Configuration, select SAVE. When creating SAVE volumes on Symmetrix systems running Enginuity 5876 for VMAXe, this field is set to 2-Way Mir, by default.
5. Select the Disk Technology.
6. External disk technology is an option if the Symmetrix system has FTS (Federated Tiered Storage) enabled and available external storage.
7. Select the Emulation type.
8. Select the RAID Protection level.
9. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
10. To add the new volumes to a specific pool, select one from Add to pool. SNAP and SRDF/A DSE pools listed are filtered on technology, emulation, and protection type selected above.
11. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

If Auto meta is enabled on the system then it displays as enabled with a green check mark.

Setting Advanced options:

a. Select the Disk Group (number and name) in which to create the volumes. The list of disk groups is already filtered based on technology type selected above.

b. To enable the new volumes in the pool, select Enable volume in pool. If Auto meta is enabled on the system then it displays as enabled with a green check mark.

c. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more
Creating thin volumes (Enginuity 5773 or 5876)

This procedure explains how to create thin volumes on storage systems running Enginuity version 5773 or 5876. For instructions on creating thin volumes on storage systems running HYPERMAX OS 5977 or higher, refer to Creating thin volumes (HYPERMAX OS 5977) on page 213.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In Volume Type, click Virtual.
4. Select Configuration (TDEV or BCV + TDEV) or thin volumes.
5. Select the Emulation type.
6. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
7. To bind the new volumes to a specific thin pool, select one from Bind to Pool. Only thin pools with enabled DATA volumes and matching emulation are available for binding (except AS/400 which will bind to an FBA pool).
8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options:

a. To name the new volumes, select one of the following Volume Identifiers and type a Name:
   - None — Allows the system to name the volumes (Default).
   - Name Only — All volumes will have the same name.
   - Name + VolumeID — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
   - Name + Append Number — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

   For more information on naming volumes, refer to Setting volume names on page 226.

b. To Allocate Full Volume Capacity, select the option.
c. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

d. To assign **Dynamic Capability** to the volumes, select one of the following; otherwise, leave this field set to **None**.

- **RDF1_Capable** — Creates a dynamic R1 RDF volume.
- **RDF2_Capable** — Creates a dynamic R2 RDF volume.
- **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:

- **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
- **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

f. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Creating thin volumes (HYPERMAX OS 5977)**

This procedure explains how to create thin volumes on VMAX systems running HYPERMAX OS 5977. For instructions on creating thin volumes on storage systems running Enginuity 5773 or 5876, refer to Creating thin volumes (Enginuity 5773 or 5876) on page 212.

**Procedure**

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes** under **Common Tasks** to open the **Create Volume** dialog box.
3. Select TDEV as the **Configuration**.
4. Select the **Emulation** type.
5. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
6. Optional: To add the volumes to a storage group, click **Select**, select the storage group, and then click **OK**.
7. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Click Show Advanced to set the advanced options:

- If creating thin volumes or a thin BCVs, you can specify to Allocate Full Volume Capacity. In addition, you can mark the preallocation on the thin volume as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations.

- To name the new volumes, select one of the following Volume Identifiers and type a Name:
  - None — Allows the system to name the volumes (Default).
  - Name Only — All volumes will have the same name.
  - Name + VolumeID — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
  - Name + Append Number — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 226.

- Do one of the following:
  - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand Add to Job List, and click Run Now to perform the operation now.

Creating virtual gatekeeper volumes

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to create virtual gatekeeper volumes.

Procedure

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In Volume Type, click Virtual.
4. Select Virtual Gatekeeper as the Configuration.
5. Optional: Select the Emulation type.
6. Type the Number of Volumes.
7. Optional: To add the volumes to a storage group, click Select, select the storage group, and then click OK.
8. Do one of the following:
Creating volumes using storage templates

This procedure explains how to use storage templates to create volumes on Symmetrix systems running Enginuity 5773 or 5876:

**Procedure**

1. Select the storage system.
2. Hover the cursor over the Storage menu and select Create Volumes under Common Tasks to open the Create Volume dialog box.
3. In Volume Type, click Template.
4. Type the name of the Template to use when creating the volumes, or click Select to open a dialog box from which you can select a template.
5. Type the Number of Volumes to create. This field appears populated or dimmed if the template you are using contains a total capacity value.
6. If Auto meta is enabled on the system then it displays as enabled with a green check mark.
7. Do one of the following:

   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

**Setting Advanced options:**

To name the new volumes, select one of the following Volume Identifiers and type a Name:

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 226.

Do either of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
Creating VDEV volumes

**Procedure**

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes** under **Common Tasks** to open the **Create Volume** dialog box.
3. In **Volume Type**, click **Virtual**.
4. Select **VDEV** as the **Configuration**.
5. Select the **Emulation** type.
6. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**.
   
   If Auto meta is enabled on the system then it displays as enabled with a green check mark.

7. **z/OS Only**: Type the SSID for the new volume, or click **Select...** to open a dialog from which you can select an SSID. This is required for volumes on storage systems with ESCON or FICON directors (or mixed systems). This field is optional on storage systems running Enginuity 5773 or higher when reducing the number of mirrors.

8. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

**Setting Advanced options:**

a. **View Enable SCSI3 Persistent Reservation status** — For Enginuity 5876 and higher this feature is pre-set by SYMAPI and cannot be changed. It is displayed as enabled for Enginuity 5876 and higher, except for CDK and AS/400 emulations.

b. If Auto Meta is enabled for the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:
   - **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
   - **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

c. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List** and click **Run Now** to create the volumes now.
Deleting volumes

This procedure explains how to delete volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204.
4. Select the volumes and click Delete.
5. Click Delete in the confirmation dialog box.

Duplicating volumes

Before you begin

You cannot duplicate RDF, SFS, or VAULT volumes.
If you are duplicating a thin volume that is bound to a pool, the newly created volumes will be bound to the same pool.
If you are duplicating a DATA volume that is part of a pool, the newly created DATA volumes will be part of the same pool. The initial state of the volume will be DISABLED.

The following explains how to duplicate volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204.
4. Select the volume, click more ..., and click Duplicate Volume to open the Duplicate Volume dialog box.
5. Type the Number of Volumes (duplicates) to make.
6. z/OS Only: You can optionally change the SSID number for the new volumes by typing a new value, or clicking Select... to open a dialog from which you can select an SSID. By default, this field displays the SSID of the volume you are copying.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List and click Run Now to create the volumes now.
   - Click Show Advanced to continue setting the advanced options, as described next.
     Setting Advanced options:
a. To name the new volumes, select one of the following Volume Identifiers and type a Name:

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 226.

b. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Assigning Symmetrix priority to individual volumes**

**Before you begin**

This feature requires Enginuity 5773 or 5876.

To assign host priority to individual volumes:

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Select the type of volumes from the tree menu, and click **View** to open the corresponding volume list view.
4. Select one or more volumes, click more, and select Assign Symmetrix Priority to open the Assign Symmetrix Priority dialog box.
5. Optional: Click **Show Selected Volumes** to view details on the selected volumes.
6. Select a Symmetrix Priority from 1 (the fastest) to 16 (the slowest) and click **OK**.
7. Click **OK** in the confirmation message.

**Assigning Symmetrix priority to groups of volumes**

**Before you begin**

This feature requires Enginuity 5773 or 5876.

This procedure explains how to prioritize the service time of the host I/O to groups of volumes (DGs or SGs).
Procedure
1. Select the storage system.
2. To assign priority to storage groups, select Storage > Storage Groups to open the Storage Groups list view.
3. To assign priority to storage groups, select Storage > Storage Groups to open the Storage Groups list view.
4. To assign priority to device groups, select Data Protection > Device Groups to open the Device Groups list view.
5. Click more and select Assign Symmetrix Priority to open the Assign Symmetrix Priority dialog box.
6. Optional: Click Show Selected Volumes to view details on the selected volumes.
7. Select a Symmetrix Priority from 1 (the fastest) to 16 (the slowest) and click OK.
8. Click OK in the confirmation message.

Changing volume configuration

Before you begin
- On storage systems running Enginuity 5876 or higher, you cannot increase or decrease the mirror protection of a volume.
- When adding DRV attributes, volumes must be unmapped.
- Full swap operations require the R1 and R2 devices to be the same size.
- Only the head of a metavolume can have its type changed. The metamembers will automatically have the changes applied.
- You cannot convert one member of a RAID set to unprotected without converting all the members to unprotected.
- When adding/removing SRDF attributes, there are no restrictions on I/O. The SRDF pair must be split or failed over. If failed over, the R1 device must be unmapped.
- When adding/removing BCV attributes, there are no restrictions on I/O. The standard/BCV pair must be split.

This procedure explains how to change a volume's configuration.

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
3. Select one or more volumes, click more, and click Change Volume Configuration to open the Change Volume Configuration dialog box.
   Optional: To view details on the selected volumes, click Show Selected Volumes.
4. Select a New Configuration for the selected volumes. Only valid configurations are listed. The remaining fields in the dialog box are active or inactive depending on the configuration type.
5. z/OS Only: Type the SSID for the new volume created by removing a mirror, or click Select... to open a dialog from which you can select an SSID.
This is required for volumes on Symmetrix systems with ESCON or FICON directors (or mixed systems). This field is optional on Symmetrix systems running Enginuity 5773 or higher when reducing the number of mirrors.

6. To reserve the volumes, select **Reserve Volumes**.

   In addition you can also type reserve comments and select an Expiration date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List** and click **Run Now** to run the job now.

### Expanding existing volumes

**Before you begin**

- Requires HYPERMAX OS 5977 or later (HYPERMAX OS 5977 Q2 2017 SR or later for CKD volumes).
- You must be logged in as an Administrator.
- You can expand a volume up to 64 TB (for FBA volumes) or 1,182,006 cylinders (for CKD volumes).
- When expanding a CKD volume above 565,250 cylinders, the new size must be a multiple of 1113 cylinders. If you specify an amount that is not a multiple, the system rounds it up.
- You cannot expand a FBA volume when any of the following operations are in progress:
  - Free all
  - Reclaim
  - Deallocation
- Restrictions apply when a volume:
  - is a gatekeeper
  - is an ACLX
  - is Celerra FBA
  - is AS400
  - is VP encapsulated
  - is part of a SnapVX session defined
  - is being replicated
  - is part of an SRDF pair
  - is part of an ORS session
  - a TDAT
- For CKD volumes, you cannot expand a volume that is:
  - A CKD 3380 volume
  - Marked as Soft Fenced
Procedure

1. Select the storage system.

2. Open the Expand Volume dialog box in either of the following ways:
   - From the Storage Group Volumes list:
     a. Click Storage > Storage Groups Dashboard.
     b. Click Total.
     c. Select the storage group and click View Details.
     d. In the Related Objects pane, click Volumes. The Storage Group
        Volumes List view displays.
     e. Do one of the following:
        - Select a volume and click Expand Volume.
        - Select a volume, click View Details and then click Expand
          Volume.
   - From the Volumes list.
     a. Click Storage > Volumes.
     b. Select a volume and click Expand Volume.

   The Expand Volume dialog box appears.

3. In the Volume Capacity field of the Expand Volume dialog box, type or select
   the new capacity of the volume. The Total Capacity and Additional Capacity
   figures update automatically.

4. To reserve the volume, select Reserve Volumes.

5. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule
     or run the task at your convenience. For more information, refer to
     Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Mapping volumes

Procedure

1. Select the storage system.

2. Select Storage > Volumes.

3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher),
   or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For
   information on using these components, refer to Managing volumes
   (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes
   (Enginuity 5773 or 5876) on page 204 respectively.

4. Select one or more volumes and click Map to open the mapping
   wizard.

5. Select one or more Ports.
Unmapping volumes

This procedure explains how to unmap volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204 respectively.
4. Select one or more volumes and click `>` and Unmap to open the Unmap Volumes wizard.
5. Select one or more ports.
6. To reserve the volumes, select Reserve Volumes. In addition you can also type reserve Comments and select an Expiration. The default values for Reserve Volumes and Comments are set in Setting system preferences on page 48 for
volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

7. Click **Next**.
8. Verify your selections in the Summary page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.
9. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Setting optimized read miss**

**Before you begin**

The optimized read miss feature is supported only for EFD volumes with FBA or AS400 D910 emulation attached to an XtremSW Cache Adapter. However, starting with Enginuity 5876.280, you can use optimized read miss without a XtremeSW Cache Adapter. To use optimized read miss without the adapter, you must set the **Optimized Read Miss** mode to **On**.

The optimized read miss feature reduces I/O processing overhead of read miss operations for both DA and DX emulations. The feature is supported on storage systems running Enginuity 5876.163.105 or higher. This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to set the optimized miss feature at the volume level. You can also perform this operation at the storage group or the device group level.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volumes Dashboard**.
3. In the **All Volumes** panel, double-click the volume type to open its list view.
4. Select one or more volumes, click more ..., and select **Set Optimized Read Miss** to open the **Optimized Read Miss** dialog box.
5. Optional: Click **Show Selected Volumes** to view details on the selected volumes.
6. Select a **Set Optimized Read Miss** mode:
   - **System Default**—Storage system determines whether to enable or disable optimized read miss mode for the specified volumes/group.
   - **Off**—Disables optimized read miss mode, regardless of the configuration.
   - **On**—Enables optimized read miss mode for both XtremCache and non-XtremCache EFD-only configurations.
7. Click **OK**.

**Setting volume status**

**Before you begin**

You cannot set the status of an unbound thin volume.

To set volume status for individual volumes:
Procedure

1. Select the storage system.

2. Select Storage > Volumes.

3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204 respectively.

4. Select one or more volumes, click more, and select Set Volume Status to open the Set Volume Status dialog box.

5. To view details on the selected volumes, click Show Current Volumes.

6. Set Volume Status. Possible values are:
   - Read/Write Enable — Changes the write-protect status of the volumes to be read and write enabled on the specified director port(s) for any locally attached hosts.
   - Write Disable — Changes the write-protect status of the volumes to be write disabled on the specified director ports for any locally attached hosts. This option will only work on volumes that are in a write enabled state.
   - Device Ready — Changes the User Ready status of the volumes to Ready.
   - Device Not Ready — Changes the User Ready status of the volumes to Not Ready.
   - Hold — Causes the Hold bit to be placed on a volume. The Hold bit is automatically placed on the target volume of a Snap session.
   - Unhold — Causes the Hold bit to be removed from a volume. The Hold bit is automatically removed from the target volume of a snap session when the snap session is removed.

7. Optional: For HYPERMAX OS 5977 or higher, select SRDF/Metro.

8. Optional: To force the operation when the operation would normally be rejected, select SymForce, if available.

9. If the selected volumes are mapped, you can select to change the status for a particular Director or all directors.

10. Click OK.

Setting volume attributes

Before you begin

You cannot set attributes for DATA volumes.

Setting attributes for CKD volumes is not supported. If attempting to set attributes for multiple volumes of type FBA and CKD, a warning is displayed stating that the action will be applied only to FBA volumes.

Setting the volume attribute for a volume restricts how it can be accessed.

To set volume attributes:

Procedure

1. Select the storage system.

2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204 respectively.

4. Select one or more volumes, click more, and select Set Volume Attributes to open the Set Volume Attributes dialog box.

5. To view details on the selected volumes, click Show Selected Volumes.

6. Set any number of the following attributes. Note that the attributes available depend on the type of selected volumes.

- **Emulation** — Sets the emulation type for the volumes. The default is No Change. This option will appear dimmed for masked/mapped volumes, as this feature is not supported on masked/mapped volumes.

- **Dynamic RDF Capability** — Sets the volume to perform dynamic RDF operations. This feature only applies/appears for Symmetrix systems running Enginuity 5876. Possible operations are:
  - No Change — Keeps the RDF capability the same.
  - Dynamic RDF Capability — Sets the volume to perform dynamic RDF operations. This feature only applies/appears for Symmetrix systems running Enginuity 5876. Possible operations are:
    - RDF1 or RDF2 Capable — Allows the volume to be R1 or R2 (RDF swaps allowed). Select this attribute to create an R21 volume used in a Cascaded RDF operation.
    - RDF1 Capable — Allows the volume to be an R1 (no RDF swaps).
    - RDF 2 Capable — Allows the volume to be an R2 (no RDF swaps).

- **SCS13 Persistent Reservation** — Maintains any reservations (flags) whether the system goes online or offline. This field will appear dimmed for diskless volumes.

7. To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

8. Do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

- Expand Add to Job List, and click Run Now to perform the operation now.

### Setting volume identifiers

#### Procedure

1. Select the storage system.

2. Do one of the following:

   - Open the Set Volume Identifiers dialog box from the Volumes list.
     a. Select Storage > Volumes.
     Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing...
Select one or more volumes, click more, and select **Set Volume Identifiers**.

- Open the **Set Volume Identifiers** dialog box from the **Protocol Endpoints** list.
  - Select **Storage > VVols Dashboard**.
  - Click **Protocol Endpoints**. The **Protocol Endpoints** list displays.
  - Select one or more protocol endpoints, and click **Set Volume Identifiers**.

The **Set Volume Identifiers** dialog box displays.

- To view details on the selected volumes, click **Show Current Volumes**.
- Type the **Volume Identifier Name**. Volume identifier names must be unique from other volumes on the Symmetrix system and cannot exceed 64 characters. Only alphanumeric characters and underscores ( _ ) are allowed.
- Type the **Volume HP Identifier Name**. HP identifier names must be a user-defined volume name (not to exceed 64 alpha-numeric characters and underscores ( _ ) ) applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID. This attribute will appear grayed out for diskless volumes.
- Type the **Volume VMS Identifier Name**. VMS identifier names must be a numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID. This attribute will appear grayed out for diskless volumes.
- To reserve the volumes, select **Reserve Volumes**. In addition you can also type reserve **Comments** and select an **Expiration** date. The default values for **Reserve Volumes** and **Comments** are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

Do one of the following:
  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Setting volume names**

When creating or duplicating volumes; or creating or expanding storage groups, you can optionally name the new volumes.

When naming volumes, you should be aware of the following:

- Volume names cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and periods ( . ) are allowed.
- Volume names plus an optional suffix cannot exceed 64 characters. If using a numerical suffix, volume names cannot exceed 50 characters (prefix) and the trailing numerical suffix number cannot exceed 14 characters. If not using a
numerical suffix, all 64 characters can be specified for the volume name. The maximum starting suffix is 1000000.

- This feature is not supported for the following types of volumes: SFS, DRV, Meta members, SAVE, DATA, Vault, and diskless.

Creating private volumes

The following private volumes can be created:

- Creating DATA volumes on page 206
- Creating diskless volumes on page 207
- Creating DRV volumes on page 208
- Creating gatekeeper volumes on page 209
- Creating SAVE volumes on page 211

Releasing volume locks

This procedure explains how to release volume locks.

During TimeFinder and SRDF control operations (and configuration actions), a volume lock is maintained on BCV and RDF pairs. If you have a lock that has lasted over 2 hours, and you confirm that no one is using the volume resources, you can release the lock.

Use the release lock action only if you believe that the volume lock was forgotten, and there are no other operations in progress for the specified volumes (local or remote).

**Procedure**

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In Volume Type, select the type of volume on which you want to release the lock.
4. Click View to open the volume list view.
5. Select one or more volumes, click more, and select Volume Lock Maintenance to open the Volume Lock Maintenance dialog box.
6. Click Unlock.
7. Click Yes.

Select Storage Group

Use this dialog box to select a storage group for the operation.

Viewing CKD volume details

This procedure explains how to view CKD volume details.

**Procedure**

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volumes panel, select the type of CKD volume.
4. To display only CKD volumes in the Volumes panel, set the Emulation filter to CKD.
5. Click **View** to open the **CKD Volumes** list view.

6. Select a CKD volume and click **View Details** to open the **Details** view.

   The **Details** view allows you to view and manage a volume.

   The following properties display:
   - **Name** — Volume name.
   - **Volume Identifier** — Volume identifier.
   - **Type** — Volume configuration.
   - **Status** — Volume status.
   - **Reserved** — Whether the volume is reserved.
   - **Capacity (GB)** — Volume capacity in GBs.
   - **Capacity (MB)** — Volume capacity in MBs.
   - **Capacity (Cylinders)** — Volume capacity in cylinders.
   - **Emulation** — Volume emulation.
   - **Symmetrix ID** — Symmetrix system on which the volume resides.
   - **Symmetrix Volume ID** — Symmetrix volume name/number.
   - **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
   - **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
   - **Nice Name** — Nice name generated by Symmetrix Enginuity.
   - **WWN** — World Wide Name of the volume.
   - **DG Name** — Name of the device group in which the volume resides, if applicable.
   - **CG Name** — Name of the device group in which the volume resides, if applicable.
   - **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
   - **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
   - **RDF Type** — RDF configuration.
   - **Geometry - Type** — Method used to define the volume's geometry.
   - **Geometry - Number of Cylinders** — Number of cylinders.
   - **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
   - **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
   - **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
   - **Geometry - Capacity (GB)** — Geometry capacity in GBs.
   - **Geometry - Limited** — Indicates whether the volume is geometry limited.
   - **SSID** — Subsystem ID.
• Capacity (Tracks) — Capacity in tracks.
• SA Status — Volume SA status.
• Host Access Mode — Host access mode.
• Pinned — Whether the volume is pinned.
• RecoverPoint tagged — Indicates whether volume is tagged for RecoverPoint.
• Service State — Service state.
• Defined Label Type — Type of user-defined label.
• Dynamic RDF Capability — RDF capability of the volume.
• Mirror Set Type — Mirror set for the volume and the volume characteristic of the mirror.
• Mirror Set DA Status — Volume status information for each member in the mirror set.
• Mirror Set Invalid Tracks — Number of invalid tracks for each mirror in the mirror set.
• Priority QoS — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
• Dynamic Cache Partition Name — Name of the cache partition.

The following controls are available:
• Duplicate Volume — Duplicating volumes on page 217
• Set Volume Attributes — Setting volume attributes on page 224
• Set Volume Identifiers — Setting volume identifiers on page 225
• Set Volume Status — Setting volume status on page 223
• Change Volume Configuration — Changing volume configuration on page 219
• Replication QoS — QOS for replication on page 235
• Assign Dynamic Cache Partition — Assigning dynamic cache partitions on page 896
• Assign Symmetrix Priority — Assigning Symmetrix priority to individual volumes on page 218

Viewing CKD volumes

Procedure
1. Select the storage system.
2. Do one of the following:
   • For storage systems running Enginuity versions 5773 or 5876, open the CKD volumes list view from the Volumes Dashboard:
     - Select Storage > Volumes to open the Volumes Dashboard.
     - In the Volumes panel, select the type of CKD volume.
     - To display only CKD volumes in the Volumes panel, set the Emulation filter to CKD.
Click **View** to open the **CKD Volumes** list view.

- For storage systems running HYPERMAX OS 5977 or higher, open the CKD volumes list view from the Volumes Dashboard:
  - Select **Storage > Volumes** to open the **Volumes Dashboard**.
  - In the Additional Criteria section, use the Volume Type category. Filter for Emulation equal to CKD-3390 or CKD-3380.
  - Click **Find**.

Use the this list view to view and manage CKD volumes.

- For storage systems running HYPERMAX OS 5977 or higher, open the CKD volumes list view from the Mainframe Dashboard:
  - Select **Hosts > Mainframe Dashboard**.
  - Click **CKD Volumes**.

Use the this list view to view and manage the volumes. The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Status**—Volume status.
- **Allocated %**—% of the volume that is allocated.
- **Pool Name**—Assigned pool name. N/A indicates that the volume is not in a pool.
- **Pool State**—Indicates the state of the volume.
- **Reserved**—Indicates whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.
- **Split**—The name of the associated split.
- **CU Image Number**—The number of the associated CU image.
- **Paths**—Number of masking records for the volume.
- **UCB Address**—Unit control block address.
- **Vol Ser**—Volume serial number.
- **Base Address**—Base Address.
- **Host Paths**—Number of masking records for the volume.

The following controls are available, however, not all controls may be available for every volume type:

- **Create Volumes**—Creating volumes on page 205
- **Delete**—Deleting volumes on page 217
- **Create SG**—Creating storage groups (HYPERMAX OS 5977 or later) on page 109
- **z/OS Map**—z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422 (HYPERMAX OS 5977 or higher)
- **z/OS Unmap**—z/OS unmap from the volume list view (HYPERMAX OS 5977 or higher) on page 423 (HYPERMAX OS 5977 or higher)
Viewing DLDEV volume details

This procedure explains how to view DLDEV volume details.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the folders and select DLDEV or volume type with DLDEV, such as RDF21+DLDEV.
4. Click View to open the DLDEV Volume list view.
5. Select a regular volume and click View Details to open the Details view.
6. The Details view allows you to view and manage a volume. This view contains two panels: Properties and Related Objects.

Properties panel

The following properties display:

- **Name** — Volume name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Dynamic Cache Partition Name** — Name of the cache partition.

• **Optimized Read Miss** — Cacheless read miss status.

The following controls are available:

• **Create Volume**—Creating diskless volumes on page 207

• **Delete**—Deleting volumes on page 217

• **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583

• **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583

• **Duplicate Volume**—Duplicating volumes on page 217

• **Set Volume Attributes**—Setting volume attributes on page 224

• **Set Volume Identifiers**—Setting volume identifiers on page 225

• **Set Volume Status**—Setting volume status on page 223

• **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896

• **Replication QoS**—QOS for replication on page 235

• **Pin**—Pinning and unpinning volumes on page 192

• **Unpin**—Pinning and unpinning volumes on page 192

• **VLUN Migration**—VLUN Migration dialog box on page 321

• **Set Optimized Read Miss**—Setting optimized read miss on page 223

**Related Objects panel**

The Related Objects panel links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Meta Members - 2** opens a view listing the two meta volume members associated with the volume.

**Viewing DLDEV volumes**

This procedure explains how to view DLDEV volumes.

**Procedure**

1. Select the storage system.

2. Select **Storage > Volumes** to open the **Volumes Dashboard**.

3. In the **Volume Type** panel, expand the folders and select DLDEV or volume type with DLDEV, such as **RDF21+TDEV**.

4. Click **View** to open the **DLDEV Volumes** list view.

   Use the list view to view and manage the volumes.

   The following properties display:

   • **Name**—Assigned volume name.

   • **Type**—Type of volume.

   • **Status**—Volume status.
Assigning dynamic cache partitions

Before you begin

This feature is not supported on HYPERMAX OS 5977 or higher.

This procedure explains how to assign dynamic cache partitions from the Volumes view. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure

1. Select the storage system.

2. Select Storage > Volumes.

   Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 and 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204.

3. Select the volumes, click more, and select Assign Dynamic Cache Partition to open the Assign Dynamic Cache Partition dialog box.
4. Optional: Click Show Selected Volumes to view details on the selected volumes.
5. Select a Dynamic Cache Partition and click OK.
6. Click OK in the confirmation message.

Setting copy pace (QoS) for device groups

Procedure
1. Select the storage system.
3. Select the device group, click more , and select Replication QoS.
   Opens the Set Replication Priority QoS dialog box.
4. Select Operation Type from the following valid values:
   - RDF — Sets the copy pace priority during RDF operations.
   - Mirror Copy — Sets the copy pace priority during mirror operations.
   - Clone — Sets the copy pace priority during clone operations.
   - VLUN — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.
5. Select the Copy Pace from the following valid value:
   - 0 -16 — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   - STOP — Stops the copy. Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
   - URGENT — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
6. If performing this operation on a group: Select the type of volumes on which to perform the operation.
7. Click OK.

QoS for replication

The QoS (Quality of Service) feature adjusts the data transfer (copy) pace on individual volumes or groups of volumes (DGs or SGs) for certain operations. By increasing the response time for specific copy operations, the overall performance of other storage volumes increases.

The following tasks are supported:
- Setting copy pace (QoS) for storage groups on page 235
- Setting copy pace (QoS) for device groups on page 235
- Setting copy pace (QoS) for volumes on page 236

Setting copy pace (QoS) for storage groups

Procedure
1. Select the storage system.
2. Do the following, depending on the array operating system:
   - For HYPERMAX OS 5977 or higher:
     a. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
     b. In the Compliance panel, click Total to open the Storage Groups list view.
   - For Enginuity 5876: Select Storage > Storage Groups to open the Storage Groups list view.

3. Perform one of the following actions:
   - For all volumes in the storage group: Select the storage group, click more , and select Replication QoS to open the Set Replication Priority QoS dialog box.
   - For some volumes in the storage group:
     a. Select a storage group.
     b. Click View Details, and select Volumes - nn from the Related Objects panel to open the Volumes list view.
     c. Select the volumes, click more , and select Replication QoS.

4. Select Operation Type from the following valid values:
   - RDF — Sets the copy pace priority during RDF operations.
   - Mirror Copy — Sets the copy pace priority during mirror operations.
   - Clone — Sets the copy pace priority during clone operations.
   - VLUN — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.

5. Select the Copy Pace from the following valid values:
   - 0 -16 — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   - STOP — Stops the copy. Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
   - URGENT — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the Operation Type is BCV, or the array is running an Enginuity version earlier than 5876.

6. Click OK.

Setting copy pace (QoS) for volumes

**Procedure**

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes dashboard.
3. In the All Volumes panel, double-click the volume type to open its list view.
4. Select one or more volumes, click more , and select Replication QoS.
   Opens the Set Replication Priority QoS dialog box.
5. Select Operation Type from the following valid values:
• **RDF** — Sets the copy pace priority during RDF operations.
• **Mirror Copy** — Sets the copy pace priority during mirror operations.
• **Clone** — Sets the copy pace priority during clone operations.
• **VLUN** — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.

6. Select the **Copy Pace** from the following valid values:
   - **0 -16** — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   - **STOP** — Stops the copy. Not supported when the **Operation Type** is BCV, or the array is running an Enginuity version lower than 5876.
   - **URGENT** — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the **Operation Type** is BCV, or the array is running an Enginuity version earlier than 5876.

7. Click **OK**.

**Managing Meta Volumes**

**Meta Members list view**

Use the Meta Members list view to view and manage the members of a meta volume. The following properties display:

- **Name**
  Volume name.

- **Type**
  Volume configuration.

- **Capacity (GB)**
  Volume capacity in GBs.

- **Meta Type**
  Meta configuration type.

- **Striped Size**
  Meta stripe size in Cylinders/Blocks.

- **Reserved**
  Whether the volume is reserved.

- **Status**
  Volume status.

The following controls are available:

- **View Details** - Viewing meta member details on page 246
- **Add Member** - Adding meta members on page 240
- **Remove Member** - Removing meta members on page 241
Creating meta volumes

Before you begin

- Meta volumes are supported on storage systems running Enginuity 5773 or 5876.
- On storage systems running Enginuity versions lower than 5876, only unmapped thin volumes (hypers) can be formed into meta volumes.
- On storage systems running Enginuity 5876 or higher:
  - Bound thin volumes can be used as meta heads; however, bound thin volumes cannot be used as meta members.
  - Unmapped thin volumes can be formed into striped meta volumes.
  - Mapped or unmapped thin volumes can be formed into concatenated meta volumes.
- For a complete list of restrictions and recommendations on creating meta volumes, refer to the Solutions Enabler Array Controls and Management CLI User Guide.
- When creating meta volumes, will attempt to instill best practices in the creation process by setting the following defaults in the Create Meta Volume wizard:
  - Meta Volume Configuration = Striped
  - Meta Volume Member Count including Head = 8

Note that these best practices do not apply to volumes created with the CKD-3390 emulation type.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the Meta Volume folder and double-click a meta type to open the Meta Volumes list view.
4. Click Create Meta Volume to open the Create Meta wizard.
5. Select the Emulation type.
6. If creating FBA volumes, select whether to create them from Create Volumes or Use Existing Volumes volumes.
7. If creating FBA or AS/400 volumes, select the Meta Volume Configuration (Concatenated or striped).
8. Select a method for forming the meta volumes.
9. Click Next.
10. Do the following, depending on the method you selected:
    - Using Existing Virtual Volumes:
      a. Type the Number of Meta Volumes to form.
      b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
      c. Select a Volume Configuration for the members.
      d. To reserve the volumes, select Reserve. In addition, you can also type reserve Comments and select an Expiration Date.
The default values for Reserve and Comments are set in Setting system preferences on page 48 for volumes reservations. If the volumes are not automatically reserved, you can optionally reserve them here.

e. If you are creating CKD meta volumes, type or select an SSID.

f. If you are creating striped meta volumes, you can optionally select the size of the meta volumes, by clicking Show Advanced, and selecting a Striped Size.

The striped size can be expressed in blocks or cylinders. Possible sizes in 512 byte blocks are 1920, 3840, 7680, 15360, 30720, and 61440. The stripe size must be 1920, which is the default for all versions of Enginuity. If no stripe size is specified when creating a striped meta, all Enginuity codes will consider the default stripe size as 1920 blocks of 512 bytes each.

g. Click Next.

- Using Existing Standard Provisioned Volumes:
  
a. Type the Number of Meta Volumes to form.

b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.

c. Select a Volume Configuration.

d. Select the RAID Protection level for the meta volumes.

e. Select the type of Disk Technology on which the meta volumes will reside.

f. Select the Disk Group (Request/Available) containing the meta volumes.

g. To reserve the volumes, select Reserve Volumes.

h. Click Next.

- By Manually Selecting Existing Volumes (Advanced):
  
a. Select from the listed volumes.

b. To reserve the volumes, select Reserve Volumes.

c. Click Next.

- Using New Standard Provisioned Volumes:
  
a. Specify the Number of Meta Volumes.

b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.

c. Select a Volume Configuration.

d. Select the RAID Protection level for the meta volumes.

e. Select the type of Disk Technology on which the meta volumes will reside.

f. Select a Disk Group.

g. If you are creating CKD meta volumes, type or select an SSID.

h. Click Next.

- Using New Virtual Volumes:
  
a. Specify the Number of Meta Volumes.

b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
c. Select a Volume Configuration.

d. Click Next.

11. Verify your selections in the Summary page. To change any of your selections, click Back.

   Note that some changes may require you to make additional changes to your configuration.

12. Click Run Now.

Adding meta members

Before you begin

- Meta volumes are supported on storage systems running Enginuity 5773 or 5876.
- To expand a bound striped thin meta volume on a storage system running an Enginuity version lower than 5876, you must first unbind the volume from the pool. This operation is allowed on storage systems running Enginuity 5876 or higher without having to unbind the volume, however, you must select the Protect Data option.
- When expanding meta thin volumes with BCV meta protection, the volumes must be fully allocated to a pool and they must have the Persist preallocated capacity through reclaim or copy option set on them. This is because binding thin meta BCV volumes is done through the pool and not through the thin BCV volume selection. For more information on allocating thin pool capacity for thin volumes, refer to Managing thin pool allocations on page 301.

Procedure

1. Select the storage system.

2. Select Storage > Volumes to open the Volume Dashboard.

3. In the Volume Type panel, double-click the type of meta volume you want to expand.

   The Meta Volumes list view opens.

4. Select the meta volume and click Add Member to open the Add Member dialog box.

5. For striped metas only: To protect the original striped meta data, do the following:
   a. Select the Protect Data option.
   b. Type or select the name of the BCV meta head to use when protecting the data.

   By default, this field is filled in with the first available BCV.

6. Select one or more volumes to add to the meta volume.

7. To reserve the volumes, select Reserve.

   In addition, you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Setting system preferences on page 48 for volumes reservations. If the volumes are not automatically reserved, you can optionally reserve them here.

8. Click Add to Job List or Run Now and refer to Managing jobs on page 871.
Removing meta members

Before you begin

- Meta volumes are supported on storage systems running Enginuity 5773 or 5876.
- You can only remove members from concatenated meta volumes.

Procedure

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volume Dashboard**.
3. In the **Volume Type** panel, double-click the meta volume type to open the **Meta Volumes** list view.
4. Select the meta volume and click **View Details** to open its **Details** view.
5. In the **Related Objects** panel, click **Meta Members** to open the **Meta Members** list view.
6. Select one or more members and click **Remove Member** to open the **Remove Meta Volume Member** dialog box.
7. To reserve the volumes, select **Reserve**. In addition you can also type reserve comment and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
8. Click **Add to Job List** or **Run Now**.

Dissolving meta volumes

Before you begin

Meta volumes are supported on storage systems running Enginuity 5773 or 5876.

Procedure

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volume Dashboard**.
3. In the **Volume Type** panel, double-click the type of meta volume you want to dissolve. The **Meta Volumes** list view opens.
4. Select the meta volume and click **Dissolve** to open the **Dissolve Meta Volume** dialog box.
5. Optional: If required, select **Reserve Volumes** and/or **Delete meta members after dissolve**.
   Note that selecting **Delete meta members after dissolve** requires the operation to be run immediately and not scheduled.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Viewing meta volumes

Before you begin

Meta volumes are supported on storage systems running Enginuity 5773 or 5876.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, double-click the meta type to open the Meta Volumes list view.

Use the Meta Volumes list view to view and manage meta volumes.

The following properties display:

- **Name**
  Volume number.

- **Type**
  Volume type.

- **Meta Config**
  Volume configuration.

- **Stripe Size**
  Meta striped size.

- **Status**
  Volume status.

- **Reserved**
  Whether the volume is reserved.

- **Capacity (GB)**
  Volume capacity in GB.

- **Emulation**
  Emulation type.

- **Paths**
  Number of masking records for the volume.

The following controls are available:

- **Create Meta Volume**—Creating meta volumes on page 238
- **Add Member**—Adding meta members on page 240
- **Dissolve**—Dissolving meta volumes on page 241
- **Convert**—Converting meta volumes on page 248
- **View Details**—Viewing meta volume details on page 243
- **Tag for RecoverPoint**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584
- **Untag for RecoverPoint**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584
Viewing meta volume details

Before you begin
Meta volumes are supported on storage systems running Enginuity 5773 or 5876.

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, double-click the meta type to open the Meta Volumes list view.
4. Select a volume and click View Details to open its Details view.

Use the meta volume Details view to view and manage a meta volume. This view contains two panels, Properties and Related Objects.

The following properties display:

- **Name**
  Volume name.

- **Physical Name**
  Physical name.

- **Volume Identifier**
  Volume identifier.

- **Type**
  Volume configuration.

- **Encapsulated Volume**
  Whether external volume is encapsulated. Relevant for external disks only.

- **Encapsulated WWN**
  World wide name for encapsulated volume. Relevant for external disks only.

- **Status**
Volume status.

**Reserved**
- Whether the volume is reserved.

**Capacity (GB)**
- Volume capacity in GBs.

**Capacity (MB)**
- Volume capacity in MBs.

**Capacity (Cylinder)**
- Volume capacity in cylinders.

**Emulation**
- Volume emulation.

**Symmetrix ID**
- Symmetrix system on which the volume resides.

**Symmetrix Volume ID**
- Symmetrix volume name/number.

**HP Identifier Name**
- User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.

**VMS Identifier Name**
- Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

**Nice Name**
- Nice name generated by Symmetrix Enginuity.

**WWN**
- World Wide Name of the volume.

**DG Name**
- Name of the device group in which the volume resides, if applicable.

**CG Name**
- Name of the device group in which the volume resides, if applicable.

**Attached BCV**
- Defines the attached BCV to be paired with the standard volume.

**Attached VDEV TGT Volume**
- Volume to which this source volume would be paired.

**RDF Type**
- RDF configuration.

**Geometry - Type**
- Method used to define the volume's geometry.

**Geometry - Number of Cylinders**
- Number of cylinders.
Geometry - Sectors per Track
   Number of sectors per track, as defined by the volume's geometry.

Geometry - Tracks per Cylinder
   Number of tracks per cylinder, as defined by the volume's geometry.

Geometry - 512 Block Bytes
   Number of 512 blocks, as defined by the volume's geometry.

Geometry - Capacity (GB)
   Geometry capacity in GBs.

Geometry - Limited
   Indicates whether the volume is geometry limited.

SSID
   Subsystem ID.

Capacity (Tracks)
   Capacity in tracks.

SA Status
   Volume SA status.

Host Access Mode
   Host access mode.

Pinned
   Whether the volume is pinned.

RecoverPoint Tagged
   Whether the volume is tagged for RecoverPoint use.

Service State
   Service state.

Defined Label Type
   Type of user-defined label.

Dynamic RDF Capability
   RDF capability of the volume.

Mirror Set Type
   Mirror set for the volume and the volume characteristic of the mirror.

Mirror Set DA Status
   Volume status information for each member in the mirror set.

Mirror Set Invalid Tracks
   Number of invalid tracks for each mirror in the mirror set.

Priority QoS
   Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

Dynamic Cache Partition Name
   Name of the cache partition.
XtremSW Cache Attached
Indicates whether XtremSW cache is attached to the volume.

Optimized Read Miss
Cacheless read miss status.

Related Objects panel
The Related Objects panel links you to views displaying objects associated with the meta volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Meta Members - 2 will open a view listing the two members in the meta volume.

Viewing meta members

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, double-click the meta type to open the Meta Volumes list view.
4. Select a volume and click View Details to open its Details view.
5. In the Related Object panel, click Meta Members to open the Meta Members list view.

Viewing meta member details

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, double-click the meta type to open the Meta Volumes list view.
4. Select a volume and click View Details to open its Details view.
5. In the Related Object panel, click Meta Members to open the Meta Members list view.
6. Select a member and click View Details to open its Details view.

Use the Meta Members details view to view and manage a meta member. The following properties display:

Name
Volume name.

Type
Volume configuration

Status
Volume status.

Reserved
Whether the volume is reserved.

Capacity (GB)
Volume capacity in GBs.
Capacity (MB)
Volume capacity in MBs.

Capacity (Cylinders)
Volume capacity in cylinders.

Emulation
Volume emulation.

Symmetrix ID
Symmetrix system on which the volume resides.

Symmetrix Volume ID
Symmetrix volume name/number.

HP Identifier Name
User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.

VMS Identifier Name
Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

Nice Name
Nice name generated by Symmetrix Enginuity.

WWN
World Wide Name of the volume.

DG Name
Name of the device group in which the volume resides, if applicable.

CG Name
Name of the device group in which the volume resides, if applicable.

Attached BCV
Defines the attached BCV to be paired with the standard volume.

Attached VDEV TGT Volume
Volume to which this source volume would be paired.

RDF Type
RDF configuration.

Geometry - Type
Method used to define the volume's geometry.

Geometry - Sectors per Track
Number of sectors per track, as defined by the volume's geometry.

Geometry - Tracks per Cylinder
Number of tracks per cylinder, as defined by the volume's geometry.

Geometry - 512 Block Bytes
Number of 512 blocks, as defined by the volume's geometry.

SSID
Converting meta volumes

**Before you begin**

Meta volumes are supported on storage systems running Enginuity 5773 or 5876. This procedure explains how to change the configuration of a meta volume.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volume Dashboard**.
3. In the **Volume Type** panel, double-click the type of meta volume you want to convert.
   
   The **Meta Volumes** list view opens.
4. Select the meta volume and click **Convert** to open the **Convert Meta Volume** dialog box.
5. If converting from concatenated to striped, you can optionally specify to protect the original striped data by selecting Protect Data and typing or selecting the BCV meta head to use when protecting the data. By default, the BCV field is filled in with the first available BCV.

6. To reserve the volumes, select Reserve.

   In addition, you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Setting system preferences on page 48 for volumes reservations. If the volumes are not automatically reserved, you can optionally reserve them here.

7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**Viewing CKD volume front end paths**

This procedure explains how to view CKD volume front end paths.

**Procedure**
1. Select the storage system.
2. Select Hosts > CU Images to open the CU Images list view.
3. Select the CU image and click View Details to open its Details view.
4. In the Related Objects panel, click Volumes to open the CKD Volumes list view.
5. Select a CKD volume and click View Details to open its Details view.
6. In the Related Objects panel, click CKD Front End Paths to open the CKS Front End Path list view.
7. The following properties display:
   8. **Director Identifier**—Director name.
   9. **Port**—Port number.
   10. **Base Address**—Assigned base address.
   11. **Alias Count**—Number of aliases mapped to the port.
   12. **Director Port Status**—Indicates port status.

**Viewing CKD volume details**

This procedure is applicable only to systems running Enginuity versions 5773 or 5876.

**Procedure**
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volumes panel, select the type of CKD volume.
4. To display only CKD volumes in the Volumes panel, set the Emulation filter to CKD.
5. Click View to open the CKD Volumes list view.
6. Select a CKD volume and click View Details to open the Details view.
The Details view allows you to view and manage a volume.

**Note**

Depending on the method you used to open this view, some of the following properties and controls may not appear.

The following properties are displayed:

- **Name**—Volume name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinders)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Storage system on which the volume resides.
- **Symmetrix Volume ID**—Storage system volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)**—Geometry capacity in GBs.
- **Geometry - Limited**—Indicates whether the volume is geometry limited.
**Viewing DATA volume information**

This procedure explains how to view DATA volume information.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Select the DATA volume and click **View Details** to open its **Details** view.
4. From the **Related Objects** panel, select **DATA Volume Info** to open the **DATA Volume Info** list view.

Use this view to view information for the DATA volume.

The following properties display:

- **Pool Name**—Name of pool where the DATA volume resides.
• **Used (GB)** — Number of GB used.
• **Total Capacity (GB)** — Total capacity in GB.
• **Used (%)** — Used capacity in %.

**Viewing masking information**

This procedure explains how to view masking information.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Select the volume and click **View Details** to open its **Details** view.
4. In the **Related Objects** panel, click **Masking Info** to open the volume’s **Masking Info** view.

   The following properties display:
   • **Director Port** — Storage system director and port.
   • **Identifier** — Volume identifier name.
   • **Type** — Director type.
   • **User Generated Name** — User-generated name.
   • **Logged In** — Indicates if the initiator is logged into the host/target.
   • **On Fabric** — Indicates if the initiator is zoned in and on the fabric.
   • **Port Flag Overrides** — Flag indicating if any port flags are overridden by the initiator: Yes/No.
   • **FCID LockDown** — Flag indicating if port lockdown is in effect: Yes/No.
   • **Heterogeneous Host** — Whether the host is heterogeneous.
   • **LUN Offset** — Whether LUN offset is enabled. This feature allows you to skip over masked holes in an array of volumes.
   • **Visibility** — Whether the port is visible to the host.

**Viewing meta volume details**

This procedure explains how to view meta volume details.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volume Dashboard**.
3. In the **Volume Type** panel, expand the **Meta Volumes** folder, select a **Volume Type** and click **View**.
4. Select a meta volume and click **View Details** to open the **Details** view.
5. The **Details** view allows you to view and manage a volume.

   This view contains two panels: **Properties** and **Related Objects**.

   Use the this list view to display and manage the volumes.

   The following properties display:
- **Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicate whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.
- **Optimized Read Miss** — Cacheless read miss status.

The following controls are available:

- **Create Volume** — Creating diskless volumes on page 207
- **Add Member** — Adding meta members on page 240
- **Dissolve** — Dissolving meta volumes on page 241
- **Convert** — Converting meta volumes on page 248
- **View Details** — Viewing meta volume details on page 243
- **Tag for Recover Point** — Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Untag for Recover Point** — Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Map** — Mapping volumes on page 221
- **Unmap** — Unmapping volumes on page 222
- **z/OS Map** — Mapping CKD volumes on page 435
- **z/OS Unmap** — Unmapping CKD volumes on page 436
- **Change Volume Configuration** — Changing volume configuration on page 219
- **Duplicate Volume** — Duplicating volumes on page 217
- **Set Volume Attributes** — Setting volume attributes on page 224
- **Set Volume Identifiers** — Setting volume identifiers on page 225
- **Set Volume Status** — Setting volume status on page 223
- **Replication QoS** — QOS for replication on page 235
- **Assign Dynamic Cache Partition** — Assigning dynamic cache partitions on page 896
Assign Symmetrix Priority—Assigning Symmetrix priority to individual volumes on page 218

Pin—Pinning and unpinning volumes on page 192

Unpin—Pinning and unpinning volumes on page 192

VLUN Migration—VLUN Migration dialog box on page 321

Set Optimized Read Miss—Setting optimized read miss on page 223

Related Objects panel

The Related Objects panel links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Meta Member - 5 opens a view listing the five members for the meta volume, excluding the meta head.

Viewing meta volume member details

This procedure explains how to view meta volume member details.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the MetaVolumes folder and select a Volume Type.
4. Click View to open the Meta Volume list view.
5. Select a meta volume and click View Details to open its Details view.

This list view can be accessed from other volumes that contain meta volumes, that is regular and virtual volumes can contain meta volumes.

Use this view to view meta volume member details.

The following properties display:

- Name—Volume name.
- Type—Volume configuration.
- Status—Volume status.
- Encapsulated Volume—Whether external volume is encapsulated. Relevant for external disks only.
- Encapsulated WWN—World Wide Name for encapsulated volume. Relevant for external disks only.
- Reserved—Whether the volume is reserved.
- Capacity (GB)—Volume capacity in GBs.
- Capacity (MB)—Volume capacity in MBs.
- Capacity (Cylinders)—Volume capacity in cylinders.
- Emulation—Volume emulation.
- Symmetrix ID—Storage system on which the volume resides.
- Symmetrix Volume ID—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)**—Geometry capacity in GBs.
- **Geometry - Limited**—Indicates whether the volume is geometry limited.
- **SSID**—Subsystem ID.
- **Capacity (Tracks)**—Capacity in tracks.
- **SA Status**—Volume SA status.
- **Host Access Mode**—Host access mode.
- **Pinned**—Whether the volume is pinned.
- **Service State**—Service state.
- **Defined Label Type**—Type of user-defined label.
- **Dynamic RDF Capability**—RDF capability of the volume.
- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status**—Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name**—Name of the cache partition.
Viewing meta volume meta members

This procedure explains how to view meta volume meta members.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the Meta Volumes folder, select a Volume Type and click View.
4. Select a meta volume and click View Details to open its Details view.
5. From the Related Objects panel, click Meta Members to open the Meta Members list view.

Use the Meta Members list view and manage the members of a meta volume, excluding the meta head.

This list view can be accessed from other volumes that contain meta volumes, that is regular and virtual volumes can contain meta volumes.

The following properties display:

- **Name**—Meta volume name.
- **Type**—Meta volume configuration.
- **Meta Type**—Meta volume type (member or tail).
- **Meta Config**—Meta volume configuration (striped or concatenated).
- **Strip Size (Cyl/Blks)**—Volume capacity in GBs.
- **Reserved**—Whether the meta volume is reserved.
- **Status**—Volume status.

The following controls are available:

- **View Details**—Viewing meta member details on page 246
- **Add Member**—Adding meta members on page 240
- **Remove Member**—Removing meta members on page 241

Viewing meta volumes

This procedure explains how to view meta volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, column expand the Meta Volume folder, select a Volume Type and click View.

Use the this list view to display and manage the volumes.

The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Meta Config**—Type of meta volume addressing.
- **Stripe Size**—Stripe size for striped volumes.
- **Status**—Volume status.
- **Reserved**—Indicates whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.
- **Paths**—Number of masking records for the volume.

The following controls are available:
- **Create Volume**—Creating diskless volumes on page 207
- **Add Member**—Adding meta members on page 240
- **Dissolve**—Dissolving meta volumes on page 241
- **Convert**—Converting meta volumes on page 248
- **View Details**—Viewing meta volume details on page 243
- **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Map**—Mapping volumes on page 221
- **Unmap**—Unmapping volumes on page 222
- **z/OS Map**—Mapping CKD volumes on page 435
- **z/OS Unmap**—Unmapping CKD volumes on page 436
- **Change Volume Configuration**—Changing volume configuration on page 219
- **Duplicate Volume**—Duplicating volumes on page 217
- **Set Volume Attributes**—Setting volume attributes on page 224
- **Set Volume Identifiers**—Setting volume identifiers on page 225
- **Set Volume Status**—Setting volume status on page 223
- **Replication QoS**—QOS for replication on page 235
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896
- **Assign Symmetrix Priority**—Assigning Symmetrix priority to individual volumes on page 218
- **Pin**—Pinning and unpinning volumes on page 192
- **Unpin**—Pinning and unpinning volumes on page 192
- **VLUN Migration**—VLUN Migration dialog box on page 321
- **Set Optimized Read Miss**—Setting optimized read miss on page 223

**Other pool information**

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the Volumes dashboard.

3. In the **All Volumes** panel, expand the **Virtual Volume** folders and select TDEV or volume type with TDEV, such as BCV+TDEV.

4. Click **View** to open the **Thin Volumes** list view.

5. Select a thin volume and click **View Details** to open its **Details** view.

6. From the **Related Objects** view, click **Other Pool Info** to open the **Other Pool Info** view.

   Use this view to view other pool information.

   The following properties display:
   - **Name**—Thin volume name.
   - **Pool Name**—Name of pool.
   - **Allocated Capacity (%)**—Percentage of pool allocated to the thin volume.
   - **Allocated (GB)**—Amount of pool allocated to the thin volume.

---

### Viewing private volumes

This procedure explains how to view the properties of private volumes.

**Procedure**

1. Select the storage system.

2. Select **Storage > Volumes**.

   Use this view to view and manage each volume contained within the volume type container.

   The following properties display:
   - **Name**—Assigned volume name.
   - **Type**—Type of volume.
   - **Status**—Volume status.
   - **Capacity (GB)**—Volume capacity in Gigabytes.
   - **Emulation**—Emulation type for the volume.

   The following controls are available:
   - **Create Volume**—[Creating private volumes](page-227)
   - **Delete**—[Deleting volumes](page-217)
   - **View Details**—[Viewing private volume details](page-259)
   - **Duplicate Volume**—[Duplicating volumes](page-217)

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### Viewing private volume details

This procedure explains how to view private volume details.

**Procedure**

1. Select the storage system.

2. Select a private volume and click **View Details** to open its **Details** view.
The Details view allows you to view and manage a volume. This view contains two panels: Properties and Related Objects.

Properties panel

The following properties display:

- **Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
• **Geometry - Capacity (GB)** — Geometry capacity in GBs.
• **Geometry - Limited** — Indicates whether the volume is geometry limited.
• **SSID** — Subsystem ID.
• **Capacity (Tracks)** — Capacity in tracks.
• **SA Status** — Volume SA status.
• **Host Access Mode** — Host access mode.
• **Pinned** — Whether the volume is pinned.
• **RecoverPoint tagged** — Indicates whether volume is tagged for RecoverPoint.
• **Service State** — Service state.
• **Defined Label Type** — Type of user-defined label.
• **Dynamic RDF Capability** — RDF capability of the volume.
• **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
• **Mirror Set DA Status** — Volume status information for each member in the mirror set.
• **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
• **Dynamic Cache Partition Name** — Name of the cache partition.

The following controls are available:

• **Create Volume** — Creating private volumes on page 227
• **Delete** — Deleting volumes on page 217
• **Duplicate Volume** — Duplicating volumes on page 217

**Related Objects** panel

The Related Objects panel links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Back End Paths- 1 opens a view listing the back end properties associated with the volume.

### Viewing regular volumes

This procedure explains how to view regular volumes

**Procedure**

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the Regular Volume folder select a Volume Type.
4. Click View to open the Regular Volumes list view.

   Use the this list view to view and manage the volumes.

   The following properties display:
- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Status**—Volume status.
- **Reserved**—Indicates whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.
- **Paths**—Number of masking records for the volume.
- **UCB Address**—Unit control block address.
- **Vol Ser**—Volume serial number.

The following controls are available, however, not all controls may be available for every volume type:

- **Create Volume**—Creating diskless volumes on page 207
- **Delete**—Deleting volumes on page 217
- **Map**—Mapping volumes on page 221
- **Unmap**—Unmapping volumes on page 222
- **View Details**—Viewing regular volume details on page 262
- **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Duplicate Volume**—Duplicating volumes on page 217
- **Set Volume Attributes**—Setting volume attributes on page 224
- **Set Volume Identifiers**—Setting volume identifiers on page 225
- **Set Volume Status**—Setting volume status on page 223
- **Change Volume Configuration**—Changing volume configuration on page 219
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896
- **Assign Symmexrix Priority**—Assigning Symmexrix priority to individual volumes on page 218
- **Replication QoS**—QOS for replication on page 235
- **Pin**—Pinning and unpinning volumes on page 192
- **Unpin**—Pinning and unpinning volumes on page 192
- **VLUN Migration**—VLUN Migration dialog box on page 321
- **z/OS Map**—Mapping CKD volumes on page 435
- **z/OS Unmap**—Unmapping CKD volumes on page 436
- **Set Optimized Read Miss**—Setting optimized read miss on page 223

### Viewing regular volume details

This procedure explains how to view regular volume details.
Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the Regular Volume folder and select a Volume Type.
4. Click View to open the Regular Volume list view.
5. Select a regular volume and click View Details to open the Details view.

The Details view allows you to view and manage a volume. This view contains two panels: Properties and Related Objects.

Properties panel
The following properties display:

- **Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
• **Geometry - Type** — Method used to define the volume's geometry.

• **Geometry - Number of Cylinders** — Number of cylinders.

• **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.

• **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.

• **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.

• **Geometry - Capacity (GB)** — Geometry capacity in GBs.

• **Geometry - Limited** — Indicates whether the volume is geometry limited.

• **SSID** — Subsystem ID.

• **Capacity (Tracks)** — Capacity in tracks.

• **SA Status** — Volume SA status.

• **Host Access Mode** — Host access mode.

• **Pinned** — Whether the volume is pinned.

• **RecoverPoint tagged** — Indicates whether volume is tagged for RecoverPoint.

• **Service State** — Service state.

• **Defined Label Type** — Type of user-defined label.

• **Dynamic RDF Capability** — RDF capability of the volume.

• **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.

• **Mirror Set DA Status** — Volume status information for each member in the mirror set.

• **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.

• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Dynamic Cache Partition Name** — Name of the cache partition.

• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Copy Pace - RDF** — Copy pace priority during RDF operations.

• **Copy Pace - Mirror Copy** — Copy pace priority during mirror operations.

• **Copy Pace - Clone** — Copy pace priority during clone operations.

• **Copy Pace - VLUN** — Copy pace priority during virtual LUN operations.

• **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.

• **Optimized Read Miss** — Cacheless read miss status.

The following controls are available:

• **Create Volume** — Creating diskless volumes on page 207

• **Delete** — Deleting volumes on page 217

• **Map** — Mapping volumes on page 221
Viewing SAVE volumes

This procedure explains how to view SAVE volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the Private Volume folder and select SAVE.
4. Click View to open the SAVE Volumes list view.

Use the this list view to view and manage the volumes.

The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Pool Name**—Pool name where the volume resides.
- **Pool Type**—Type of pool.
- **Status**—Volume status.
- **Reserved**—Indicates whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.
- **State**—Indicates whether or not the volume is enabled.

The following controls are available:

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**Note**

There are multiple ways to open this view. Depending on the one you used, some of the following controls may not appear.

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- **Create Volume**—Creating SAVE volumes on page 211
- **Delete**—Deleting volumes on page 217
- **Enable**—Enabling and disabling DATA volumes on page 291
- **Disable**—Enabling and disabling DATA volumes on page 291
- **View Details**—Viewing SAVE volume information on page 268
- **Duplicate Volume**—Duplicating volumes on page 217

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**Viewing SAVE volume details**

This procedure explains how to view SAVE volume details.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volume Dashboard**.
3. In the **Volume Type** panel, expand the **Private Volume** folder and select **SAVE**.
4. Click **View** to open the **SAVE Volumes** list view.
5. Select a SAVE volume and click **View Details** to open its **Details** view.

The **Details** view allows you to view and manage a volume.

This view contains two panels: **Properties** and **Related Objects**.

**Properties panel**

The following properties display:

- **Name**—Volume name.
- **Physical Name**—Physical name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status**—Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint tagged** — Indicates whether volume is tagged for RecoverPoint.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
• **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.

• **Mirror Set DA Status** — Volume status information for each member in the mirror set.

• **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.

• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Dynamic Cache Partition Name** — Name of the cache partition.

The following controls are available:

• **Create Volume** — Creating SAVE volumes on page 211

• **Delete** — Deleting volumes on page 217

• **Enable** — Enabling and disabling DATA volumes on page 291

• **Disable** — Enabling and disabling DATA volumes on page 291

• **Duplicate Volume** — Duplicating volumes on page 217

**Related Objects panel**

The **Related Objects** panel links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Save Volume Info** opens a view listing the additional information related to the SAVE volume.

**Viewing SAVE volume information**

This procedure explains how to view SAVE volume information.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes** to open the Volume Dashboard.
3. In the **Volume Type** panel, expand the **Private Volume** folder and select **SAVE**.
4. Click **View** to open the **SAVE Volumes** list view.
5. Select a SAVE volume and click **View Details** to open its **Details** view.
6. From the **Related Objects** panel, select **SAVE Volume Info** to open the **SAVE Volume Info** list view.

Use **SAVE Volume Info** list view to view information for the SAVE volume.

The following properties display:

• **Name** — Name of SAVE volume.

• **Pool Name** — Name of pool where the SAVE volume resides.

• **Emulation** — Emulation type for SAVE volume.

• **Status** — Status of DATA volume.

• **Used Capacity (%)** — Used capacity in %.

• **Used (GB)** — Number of GB used.

• **Free (GB)** — Free space in GB.
Viewing storage resource pool information

This procedure explains how to view storage resource pool information.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes list view.
3. Select the volume and click View Details to open its Details view.

The following properties display:

- **Name**—Volume name.
- **SRP Name**—Storage resource pool name.
- **Allocated**—Volume capacity allocated.
- **Capacity**—Total volume capacity.
- **Allocated %**—Percent of volume used.

Viewing thin volume bound pool information

This procedure explains how to view thin volume bound pool information.

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Select the thin volume and click View Details to open its Details view.
4. From the Related Objects view, click Bound Pool Info to open the Bound Pool Info view.

The following properties display:

- **Name**—Thin volume name.
- **Pool Name**—Name of pool.
- **Allocation %**—Percentage of pool allocated to the thin volume.
- **Capacity (GB)**—Capacity in GB.
- **Allocated (GB)**—Number of GB allocated from the pool for exclusive use by the thin volume.
- **Subscription %**—Ratio between the DATA volume pool’s enabled capacity and the thin volume subscribed capacity.
- **Written (GB)**—Number of allocated GB in the DATA volume pool that the thin volume has used.
- **Shared Tracks**—Whether tracks are shared between thin volumes.
- **Persistent Allocation**—Indicates persistent allocations: All, some, or none.
Viewing thin volume details

This procedure explains how to view thin volume details.

Procedure

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Select the thin volume and click **View Details** to open its **Details** view.

   The **Details** view allows you to view and manage a volume. This view contains two panels: **Properties** and **Related Objects**.

**Properties panel**

Note

Depending on the storage environment, some of the following properties may not apply.

The following properties display:

- **Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Compression ratio** — Current compression ratio for the volume.
- **Symmetrix ID** — Storage system on which the volume resides.
- **Symmetrix Volume ID** — Storage system volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **Mobility ID enabled** — Indicates if the use of mobility ID is enabled.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.

- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.

- **RDF Type**—RDF configuration.

- **Geometry - Type**—Method used to define the volume's geometry.

- **Geometry - Number of Cylinders**—Number of cylinders.

- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.

- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.

- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.

- **Geometry - Capacity (GB)**—Geometry capacity in GBs.

- **Geometry - Limited**—Indicates whether the volume is geometry limited.

- **SSID**—Subsystem ID.

- **Capacity (Tracks)**—Capacity in tracks.

- **SA Status**—Volume SA status.

- **Host Access Mode**—Host access mode.

- **Pinned**—Whether the volume is pinned.

- **RecoverPoint Tagged**—Indicates whether volume is tagged for RecoverPoint.

- **Service State**—Service state.

- **Defined Label Type**—Type of user-defined label.

- **Dynamic RDF Capability**—RDF capability of the volume.

- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.

- **Mirror Set DA Status**—Volume status information for each member in the mirror set.

- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.

- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

- **Dynamic Cache Partition Name**—Name of the cache partition.

- **XtremSW Cache Attached**—Indicates whether XtremSW cache is attached to the volume.

- **Compression Size**—Amount of the volume compressed in GB.

- **Compression Ratio**—Amount of the volume compressed in %.

- **Compression Size Per Pool**—Amount of the volume compressed per pool in GB.

- **Optimized Read Miss**—Cacheless read miss mode.

- **Persistent Allocation**—Indicates whether the thin volume has persistent allocations. Possible values are: All, Some, or None.

The following controls are available:
Note

Depending on the storage environment, some of the following controls may not be available.

- **Create Volume**—Creating thin volumes (Enginuity 5773 or 5876) on page 212
- **Delete**—Deleting volumes on page 217
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584 (Not supported on storage systems running HYPERMAX OS 5977)
- **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584 (Not supported on storage systems running HYPERMAX OS 5977)
- **Rebind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **Change Volume Configuration**—Changing volume configuration on page 219
- **Duplicate Volume**—Duplicating volumes on page 217
- **Set Volume Attributes**—Setting volume attributes on page 224
- **Set Volume Identifiers**—Setting volume identifiers on page 225
- **Set Volume Status**—Setting volume status on page 223
- **Start Allocate/Free/Reclaim**—Managing thin pool allocations on page 301, Managing thin pool capacity on page 304, Managing space reclamation on page 302
- **Stop Allocate/Free/Reclaim**—Managing thin pool allocations on page 301, Managing thin pool capacity on page 304, Managing space reclamation on page 302
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 234
- **Replication QoS**—QOS for replication on page 235
- **Map**—Mapping volumes on page 221
- **Unmap**—Unmapping volumes on page 222
- **Pin**—Pinning and unpinning volumes on page 192
- **Unpin**—Pinning and unpinning volumes on page 192
- **VLUN Migration**—VLUN Migration dialog box on page 321
- **VP Compression**—Managing VP compression on storage groups on page 138
- **z/OS Map**—Mapping CKD volumes on page 435
- **z/OS Unmap**—Unmapping CKD volumes on page 436
- **Set Optimized Read Miss**—Setting optimized read miss on page 223

The Related Objects panel links you to views displaying objects contained in and associated with the thin volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example,
Viewing thin volumes

This procedure explains how to view thin volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes.

Use the Thin Volumes list view to view and manage the volumes.

The following properties display:

- **Name**—Assigned volume name.
- **Pool Name**—Assigned pool name. N/A indicates that the volume is not in a pool.
- **Type**—Type of volume.
- **Allocated %**—Percentage of volume allocated.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Pool State**—Pool state.
- **Status**—Volume status.
- **Emulation**—Emulation type for the volume.
- **Host Paths**—Number of masking records for the volume.
- **Reserved**—Indicates whether the volume is reserved.
- **Paths**—Number of masking records for the volume.
- **UCB Address**—Unit control block address.
- **Vol Ser**—Volume serial number.

The following controls are available:

- **Create Volume**—Creating diskless volumes on page 207
- **Delete**—Deleting volumes on page 217
- **Create SG**—Creating storage groups (HYPERMAX OS 5977 or later) on page 109
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **View Details**—Viewing thin volume details on page 270
Viewing VDEV volumes

This procedure explains how to view VDEV volumes.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the folders and select VDEV.
4. Click View to open the VDEV Volumes list view.

Use the this list view to view and manage the volumes.

The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
• **Status**—Volume status.
• **Reserved**—Indicates whether the volume is reserved.
• **Capacity (GB)**—Volume capacity in Gigabytes.
• **Emulation Type**—Emulation type for the volume.
• **Paths**—Number of masking records for the volume.

The following controls are available:

- **Create Volume**—Creating VDEV volumes on page 216
- **Delete**—Deleting volumes on page 217
- **z/OS Map**—Mapping CKD volumes on page 435
- **z/OS Unmap**—Unmapping CKD volumes on page 436
- **View Details**—Viewing VDEV volume details on page 276
- **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Duplicate Volume**—Duplicating volumes on page 217
- **Set Volume Attributes**—Setting volume attributes on page 224
- **Set Volume Identifiers**—Setting volume identifiers on page 225
- **Set Volume Status**—Setting volume status on page 223
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896
- **Map**—Mapping volumes on page 221
- **Unmap**—Unmapping volumes on page 222
- **Pin**—Pinning and unpinning volumes on page 192
- **Unpin**—Pinning and unpinning volumes on page 192
- **VLUN Migration**—VLUN Migration dialog box on page 321
- **Replication QoS**—QOS for replication on page 235
- **Set Optimized Read Miss**—Setting optimized read miss on page 223

5. **z/OS Map** —LINK
6. **z/OS Unmap** —LINK
7. **View Details** — LINK
8. **Tag for Recover Point** —LINK
9. **Untag for Recover Point** — LINK
10. **Duplicate Volumes** —LINK
11. **Set Volume Attributes** —LINK
12. **Set Volume Identifiers** —LINK
13. **Set Volume Status** —LINK
14. **Assign Dynamic Cache Partition** — LINK
15. **Map** —LINK
16. **Unmap** — LINK
Viewing VDEV volume details

This procedure explains how to view VDEV volume details.

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes Dashboard.
3. In the Volume Type panel, expand the folders and select VDEV.
4. Click View to open the VDEV Volumes list view.
5. Select a volume and click View Details to open its Details view.

The Details view allows you to view and manage a volume.

This view contains two panels: Properties and Related Objects.

Properties panel

The following properties display:

- **Name** — Volume name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **Optimized Read Miss** — Cacheless read miss status.

The following controls are available:
- **Create Volume** — Creating VDEV volumes on page 216
- **Delete** — Deleting volumes on page 217
- **z/OS Map** — Mapping CKD volumes on page 435
- **z/OS Unmap** — Unmapping CKD volumes on page 436
- **Tag for Recover Point** — Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
- **Untag for Recover Point** — Tagging and untagging volumes for Recoverpoint (storage group level) on page 583
Viewing volume details

For details for a specific volume type, refer to the following:

Procedure

1. Viewing DATA volume details on page 293
2. Viewing DLDEV volume details on page 231
3. Viewing CKD volume details on page 249
4. Viewing meta volume details on page 252
5. Viewing private volume details on page 259
6. Viewing regular volume details on page 262
7. Viewing SAVE volume details on page 266
8. Viewing thin volume details on page 270
9. Viewing VDEV volume details on page 276

Viewing volume back end paths

This procedure explains how to view volume back end paths.

Procedure

1. Select the storage system.
2. Select a volume and click View Details to open its Details view.
3. In the Related Objects panel, click Back End Paths to open the list of Back End Paths.

This view allows you to view the back end paths associated with the volume.

The following properties display:
• **Dev**—Dev ID.
• **Spindle**—Spindle ID.
• **Director Identifier**—Director identifier.
• **DA Interface**—DA interface ID.
• **Disk SCSI ID**—Disk SCSI ID.
• **DA volume**—DA volume ID.
• **Hyper Number**—Hyper ID.
• **Hyper Capacity (GB)**—Type of hyper.
• **Disk Capacity (GB)**—Capacity of disk in GB.
• **Disk Group Name**—Name of disk group.
• **Member Status**—Hyper member status.
• **Member Number**—Hyper member number.

### Viewing volume controls

For controls for a specific volume type, refer to the following:

**Procedure**

1. Viewing CKD volume details on page 249
2. Viewing DATA volumes on page 292
3. Viewing DLDEV volumes on page 233
4. Viewing meta volumes on page 257
5. Viewing private volumes on page 259
6. Viewing regular volumes on page 261
7. Viewing SAVE volumes on page 265
8. Viewing thin volumes on page 273
9. Viewing VDEV volumes on page 274

### Viewing volume FBA front end paths

This procedure explains how to view volume FBA front end paths.

**Procedure**

1. Select the storage system.
2. Select a volume and click **View Details** to open its **Details** view.
3. In the **Related Objects** panel, click **FBA Front End Paths** to open the **FBA Front End Paths** list view.
   
   Use the **FBA Front End Paths** list view to view the FBA front end paths associated with a volume.
   
   The following properties display:

   • **Director Identifier**—Director name.
   • **Port**—Port number.
   • **VBus**—VBus number.
Viewing volume RDF information

This procedure explains how to view volume RDF information.

Procedure

1. Select the storage system.
2. Select a volume and click **View Details** to open its **Details** view.
3. In the **Related Objects** panel, click **RDF Info** to open the **RDF Info** list view.

The following properties display:

- **Remote SymmID**—Remote Symmetrix serial ID.
- **RDev**—Symmetrix volume name.
- **RDev Config**—Volume configuration.
- **Capacity (GB)**—Volume capacity.
- **RDFG**—RDF group containing the volume.
- **Pair State**—State of the pair of which the volume is part.
- **RDF Feature**—SRDF copy type.
- **CSRMT**—CSRMT—R DFA Flags:

| (C)onsistency: | X = Enabled, . = Disabled, - = N/A |
| (S)tatus : | A = Active, I = Inactive, - = N/A |
| (R)DFA Mode : | S = Single-session, M = MSC, - = N/A |
| (M)sc Cleanup: | C = MSC Cleanup required, - = N/A |
| (T)ransmit Idle: | X = Enabled, . = Disabled, - = N/A |
| (D)SE Status: | A = Active, I = Inactive, - = N/A |
| DSE (A)utostart: | X = Enabled, . = Disabled, - = N/A |

- **R1 Inv**—Number of invalid tracks on the R1 volume.
- **R2 Inv**—Number of invalid tracks on the R2 volume.
- **RA Status**—Status of the RDF director.
- **Link Status**—Indicates link state.
- **RDF State**—Volume RDF state.
- **Remote RDF State**—Remote volume RDF state.
- **RDF Status**—Volume RDF status.
- **Device Config RDFA WPACE Exempt**—Indicates is write pacing exemption capability is enabled or disabled.
Effective RDFA WPACE Exempt—indicates if effective write pacing exemption capability is enabled or disabled.

Select Volume Range dialog box

Use this dialog box to select the range of volumes for the operation.

The following properties display:

- **Volume Range**—Range of volumes.
- **CU Image Number**—CU image containing the volumes.
- **SSID**—Subsystem ID assigned to the volumes.
- **Base Address**—Base addresses assigned to the volumes.
- **Aliases**—Aliases assigned to the volumes.

Viewing disk groups

**Procedure**

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Groups list view.

   Use this list view to view and manage disk groups.
   The following properties display:
   - **Name**—Name of disk group name, format: number -- name.
   - **Technology**—Technology type for the disk group.
   - **Disk Location**—Indicates whether disk is internal or external.
   - **Disks**—Number of disks in the disk group.
   - **Used Capacity**—Percent total used capacity of the disk group, displayed in bar graph format and the actual percent number.
   - **Total Capacity (GB)**—Total capacity in GB of the disk group.

   The following controls are available:
   - **View Details**—Viewing disk group details on page 281
   - **Delete Disk Group**—Deleting disk groups on page 290

Viewing disk group details

**Procedure**

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Groups list view.
3. Select the disk group from the list and click **View Details** to open the disk group Details view.

   The following properties display:
   - **Name**—User-defined disk group name, format: number -- name.
The following controls are available:

- **Rename**—Renaming disk groups on page 290
- **Delete**—Deleting disk groups on page 290

The **Related Objects** panel provides links to views for objects contained in or associated with the disk group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking **Disks - 2** opens the view listing the two disks contained in the disk group.

The **Performance** panel links you to the performance analyze views for the group.

This panel only displays when the Performance option is installed. This panel will display with inactive links if the selected storage system is not registered for data collection.

The **Graph** panel provides a graphic representation of the percentage of disk group used capacity to the disk group total capacity.

**Viewing disks in disk group**

**Procedure**

1. Select the storage system.
2. Select **Storage > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group and click **View Details** to open its **Details** view.
4. In the **Related Objects** panel, click **Disks** to open the **Disks** list view.

Use the **Disks** list view to view and manage data disks in the disk group. The following properties display:

- **Spindle**—Disk Spindle ID.
- **Dir**—Disk director ID.
- **Int**—DA SCSI path.
- **TID**—Disk SCSI ID.
- **Vendor ID**—Disk vendor.
- **Product Revision**—Product version number.
- **Hypers**—Number of disk hypers.
- **Total Capacity (GB)**—Disk capacity.
- **Used (%)**—Percent of disk capacity.
The following controls are available:

- **View Details**—Viewing disk details on page 283
- **Remove Disks**—Removing disks from disk groups on page 289

## Viewing disk details

### Procedure

1. Select the storage system.
2. Select **Storage > Disk Groups** to open the **Disk Group** list view.
3. Select the disk group and click **View Details** to open its **Details** view.
4. In the **Related Objects** panel, select **Disks** to open the **Disks for Disk Group** list view.
5. From this list view, select a disk and click **View Details** to open the details view for the disk.

This view allows you to view the data disk details. This view contains three panels, **Properties, Related Objects, and Graphs**.

The following properties display:

- **Spindle**—Spindle ID.
- **Disk ID**—Disk identification.
- **Int**—DA SCSI path.
- **TID**—Disk SCSI ID.
- **External WWN**—World Wide Name of the external LUN.
- **Disk Group**—Disk group number.
- **Disk Location**—Location of disk.
- **Disk Technology**—Disk technology type.
- **Speed (RPM)**—Physical disk revolutions per minute.
- **Form Factor**—Form factor of the disk.
- **Vendor ID**—Disk vendor ID.
- **Product ID**—Product ID.
- **Product Revision**—Product revision number.
- **Serial ID**—Serial number.
- **Disk Blocks**—Number of disk blocks.
- **Actual Disk Blocks**—Actual number of disk blocks.
- **Block Size**—Size of each block.
- **Total Capacity (GB)**—Useable disk capacity in Gigabytes.
- **Free Capacity (GB)**—Free disk capacity in Gigabytes.
- **Actual Capacity (GB)**—Actual disk capacity in Gigabytes.
- **Used (%)**—Percentage of used disk capacity to the total disk capacity.
- **Rated Disk Capacity (GB)**—Rated capacity of the disk.
- **Spare Disk**—Indicates if disk is a spare.
- **Encapsulated**—If the disk is external, this indicates if it is encapsulated (True) or not (False).
Disk Service State—Indicates disk service state.

The following controls are available:

- **Remove**—Removing disks from disk groups on page 289

The Related Objects panel provides links to views for objects contained in or associated with the disk group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking Hypers - 2 opens the view listing the two hypers contained in the disk.

The Graph panel provides a graphic representation of the percentage of used disk capacity to the total disk capacity.

### Viewing disk hyper volumes

**Procedure**

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Groups list view.
3. Select the disk group and click View Details to open its Details view.
4. In the Related Objects panel, click Disks to open the Disks for Disk Group list view.
5. Select a disk and click View Details to open its Details view.
6. In the Related Objects panel, click Hypers to open the Hypers for Disk list view.

Use the Hypers for Disk list view to view the hyper volumes in a disk group. The following properties display:

- **Hyper**—Volume hyper number.
- **Volumes**—Disk adapter logical volume number (1 - n).
- **Hyper Type**—Hyper type.
- **Mirror**—Mirror position of hyper.
- **Capacity (GB/Cyl)**—Disk capacity in GB/Cylinders.
- **Symm Volume**—Symmetrix volume number.
- **Hyper Status**—Hyper status.
- **Emulation**—Emulation of hyper volume.

The following control is available:

- **View Details**—Viewing hyper volume details on page 284

### Viewing hyper volume details

**Procedure**

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Groups list view.
3. Select the disk group and click View Details to open its Details view.
4. In the Related Objects panel, click Disks to open the Disks for Disk Group list view.
5. Select a disk and click View Details to open its Details view.

6. In the Related Objects panel, click Hypers to open the Hypers for Disk list view.

7. Select a hyper volume and click View Details to open its Details view.

8. Use the hyper volume Details view to view the properties of a hyper volume.

The following properties display:

- Hyper Number—Volume hyper number.
- DA Volume—Disk adapter logical volume number (1 - n).
- Hyper Type—Hyper type.
- Mirror—Mirror position of hyper.
- Capacity (GB/Cyl)—Disk capacity in GB/Cylinders.
- Symm Volume—Symmetrix volume number.
- RAID Group—RAID-S group number.
- Original Mirror—Mirror position of hyper.
- Hyper Status—Hyper status.
- Emulation—Emulation of hyper volume.

**Viewing volumes for disk**

**Procedure**

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Group list view.
3. Select the disk group from the list and click View Details to open the Details view.
4. In the Related Objects panel, select Disks to open the Disks for Disk Group list view.
5. From the Disks for Disk Group list view, select a disk and click View Details to open the details view for the disk.
6. In the Related Object panel, click Volumes to open the Volumes for Disk view.

Use the Volumes for Disk view to view the properties of the volumes on the disk.

The following properties display:

- Name—Volume name.
- Type—Volume configuration.
- Capacity (GB)—Volume capacity in GBs.
- Status—Volume status.
- Reserved—Whether the volume is reserved.
- Emulation—Volume emulation.
- Pinned—Indicates whether the volume is pinned.
Viewing disk volume details

Procedure

1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Group list view.
3. Select the disk group and click View Details to open its Details view.
4. In the Related Objects panel, click Disks to open the Disks for Disk Group list view.
5. Select a disk and click View Details to open its Details view.
6. In the Related Object panel, click Volumes to open the Volumes for Disk view.
7. Select a volume and click View Details to open its details view.

Use the volume Details view to view the properties of a volume. The following properties display:

- **Name**—Volume name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Status**—Volume status.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinders)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders, as defined by the volume's geometry.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)**—Volume capacity in GBs, as defined by the volume's geometry.
- **Geometry - Limited**
- **SSID**—Subsystem ID.
- **Capacity (Tracks)**—Capacity in tracks.
- **SA Status**—Volume SA status.
- **Host Access Mode**—Host access mode.
- **Pinned**—Whether the volume is pinned.
- **Service State**—Service state.
- **Defined Label Type**—Type of user-defined label.
- **Dynamic RDF Capability**—RDF capability of the volume.
- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status**—Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name**—Name of the cache partition.

**Viewing paths for disks**

**Procedure**

1. Select the storage system.
2. Select **Storage > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group and click **View Details** to open its **Details** view.
4. In the **Related Objects** panel, click **Disks** to open the **Disks for Disk Group** list view.
5. Select a disk and click **View Details** to open its **Details** view.
6. In the **Related Objects** panel, click **Paths** to open the **Paths for Disk** list view.
Use the Paths for Disk list view to view the paths for a disk. The following properties display:

- **Dir**—Director Identifier. Possible values are a director number or the word "Multi," which indicates that the hyper can see multiple directors.
- **Port**—Director port number.
- **Remote Port WWN**—World Wide Name of the port.
- **Active Path**—Whether active path is being used (True/False).
- **Failover**—Whether failover is being used (True/False).

### Viewing spare disks in disk group

**Procedure**

1. Select the storage system.
2. Select **Storage > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group and click **View Details** to open its **Details** view.
4. In the **Related Objects** panel, click **Spare Disks** to open the **Spare Disks for Disk Group** view.

Use the **Spare Disks for Disk Group** view to view the spare disks in a disk group. The following properties display:

- **Disk ID**—Disk Identification.
- **Int**—DA SCSI path.
- **TID**—Disk SCSI ID.
- **Hypers**—Number of hypers.
- **Total Capacity (GB)**—Total disk in GB.
- **Used %**—Amount of used disk space in percent.
- **Disk Group**—Disk group number where disk is contained.
- **Speed (RPM)**—Physical disk revolutions per minute.
- **Spindle**—Spindle ID.
- **Disk Location**—Indicates whether spare disk is internal or external.
- **Failed Dir**—Failed disk director ID.
- **Failed DA Number**—Failed disk DA number.
- **Failed DA Int**—Failed disk DA SCSI path.
- **Failed Disk SCSI ID**—Failed disk SCSI ID.
- **Failed Spindle ID**—Failed disk Spindle ID.

The following controls are available:

- **View Details**—Viewing spare disk details on page 289.
Viewing spare disk details

Procedure
1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Group list view.
3. Select the disk group from the list and click View Details to open the Details view.
4. In the Related Objects panel, select Spare Disks to open the Spare Disks for Disk Group list view.
5. Select a disk and click View Details to open the its Details view.

Use the disk Details view to view the properties of a spare disk. The following properties display:
- Disk ID—Disk Identification
- Int—DA SCSI path
- TID—Disk SCSI ID
- Spindle—Spindle ID
- Disk Group—Disk group number
- Vendor ID—Disk vendor ID
- Product Revision—Product revision number
- Serial ID—Serial number
- Block Size—Size of each disk block
- Cap (GB)—Useable disk capacity in Gigabytes
- Used (%)—Percentage of used disk capacity to the total disk capacity
- Free Cap (GB)—Free disk capacity in Gigabytes
- Actual Cap (GB)—Actual disk capacity in Gigabytes
- Speed RPM—Physical disk revolutions per minute
- Disk Technology—Disk technology type
- Disk Location—Location of disk
- External WWN—External world wide name

Removing disks from disk groups

Note
Only empty external disk groups can be deleted.

Procedure
1. Select the storage system.
2. Select Storage > Disk Groups to open the Disk Groups list view.
3. Select the disk group from the list and click View Details to open its Details view.
4. From the Related Objects panel, select Disks to open the Disks view.
5. Select a disk from the list and click **Remove Disk**.
6. Click **OK**.

### Deleting disk groups

**Before you begin**

Only empty external disk groups can be deleted.

**Procedure**

1. Select the storage system.
2. Select **Storage** > **Disk Groups** to open the **Disk Groups** list view.
3. Select one or more disk groups and click **Delete Disk Group**.
4. Click **Delete** in the confirmation message.

### Renaming disk groups

**Procedure**

1. Select the storage system.
2. Select **Storage** > **Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group and click **View Details** to open its **Details** view.
4. Click **Rename** to open the **Rename Disk Group** dialog box.
5. Type the **New Name** and click **Run Now**.

### Creating DATA volumes

This procedure explains how to create DATA volumes on storage systems running **Enginuity** version 5773 or 5876.

**Procedure**

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes under Common Tasks** to open the **Create Volume** dialog box.
3. In **Volume Type**, click **Private**.
4. Select **DATA** as the **Configuration**.
5. Select the **Disk Technology**.

   **External** disk technology is an option if the storage system has FTS (Federated Tiered Storage) enabled and available external storage.

6. Select the **Emulation** type.
7. Select the **RAID Protection** level.
8. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
9. To add the new volumes to a specific thin pool, select one from **Add to Pool**. Pools listed are filtered on technology, emulation, and protection type.
10. Do one of the following:

    - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
Activating and deactivating DATA volumes

Before you begin
You can only activate deactivated DATA volumes with used tracks.

This procedure explains how to activate or deactivate DATA volumes in a thin pool. Activating volumes is essentially the same thing as enabling volumes; however, the activate operation is not allowed if draining is in progress. After activation, the volumes will go into the Enabled state.

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
   Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 and 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204.
3. To activate volumes, right-click the volumes and select Activate. To deactivate volumes, right-click the volumes and select Deactivate.
4. Click OK in the confirmation message.

Enabling and disabling DATA volumes

Before you begin
To disable a volume, all sessions must be terminated, and have no used tracks.

This procedure explains how to enable or disable DATA volumes for use in a pool. The volumes in the pool do not all have to be in the same state (enabled or disabled). If all the volumes in a pool are disabled, then the pool is disabled. If at least one volume in a pool is enabled, then the pool is enabled.
Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the Private Volume folder and select DATA.
   The DATA Volumes list view opens.
4. To enable volumes, right-click them and select Enable. To disable volumes, right-click them and select Disable.
5. Click OK.

Start draining DATA volumes
This procedure explains how to start draining DATA volumes.

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the Private Volume folder and select DATA.
4. Click View to open the DATA Volumes list view.
5. Select one or more volumes, click more, and select Start Draining.
6. Click OK.

Stop draining DATA volumes
This procedure explains how to stop draining DATA volumes.

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volume Dashboard.
3. In the Volume Type panel, expand the Private Volume folder and select DATA.
4. Click View to open the DATA Volumes list view.
5. Select one or more volumes, click more, and select Stop Draining.
6. Click OK.

Viewing DATA volumes
This procedure explains how to view and manage DATA volumes.

Procedure
1. Select the storage system.
2. Select Storage > Volumes to open the Volumes view.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204 respectively.
   The DATA volumes list view allows you to view and manage DATA volumes.
4. The following properties display:
Note

Depending on the storage environment, some of the following properties may not apply.

- **Name**—Volume name.
- **Type**—Volume configuration.
- **Pool Name**—Pool in which the volume resides.
- **Pool Type**—Type of pool in which the volume resides.
- **Capacity (GB)**—Volume capacity.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Emulation**—Volume emulation.
- **State**—Whether the volume is enabled or disabled in the pool.
- **Session Status**—Whether volume is active or inactive.

The following controls are available:

Note

Depending on the storage environment, some of the following controls may not be available.

- **Create Volume**—Creating DATA volumes on page 206
- **Delete**—Deleting volumes on page 217
- **Enable**—Enabling and disabling DATA volumes on page 291
- **Disable**—Enabling and disabling DATA volumes on page 291
- **Activate**—Activating and deactivating DATA volumes on page 291
- **Deactivate**—Activating and deactivating DATA volumes on page 291
- **View Details**—Viewing DATA volume details on page 293
- **Start Draining**—Start draining DATA volumes on page 292
- **Stop Draining**—Stop draining DATA volumes on page 292
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 234
- **Duplicate Volume**—Duplicating volumes on page 217

**Viewing DATA volume details**

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.

Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to **Managing volumes (HYPERMAX OS 5977 or higher)** on page 203 and **Managing volumes (Enginuity 5773 or 5876)** on page 204 respectively.
3. Select a DATA volume and click **View Details** to open its **Details** view.

4. The **Details** view allows you to view and manage a volume.

   This view contains two panels: **Properties** and **Related Objects**.
   The following properties display:

   **Note**
   Depending on the storage environment, some of the following properties may not apply.

   - **Name**—Volume name.
   - **Physical Name**—Physical name.
   - **Volume Identifier**—Volume identifier.
   - **Type**—Volume configuration.
   - **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
   - **Encapsulated WWN** World Wide Name for encapsulated volume. Relevant for external disks only.
   - **Status**—Volume status.
   - **Reserved**—Whether the volume is reserved.
   - **Capacity (GB)**—Volume capacity in GBs.
   - **Capacity (MB)**—Volume capacity in MBs.
   - **Capacity (Cylinders)**—Volume capacity in cylinders.
   - **Emulation**—Volume emulation.
   - **Symmetrix ID**—Symmetrix system on which the volume resides.
   - **Symmetrix Volume ID**—Symmetrix volume name/number.
   - **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
   - **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
   - **Nice Name**—Nice name generated by Symmetrix Enginuity.
   - **WWN**—World Wide Name of the volume.
   - **DG Name**—Name of the device group in which the volume resides, if applicable.
   - **CG Name**—Name of the device group in which the volume resides, if applicable.
   - **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
   - **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
   - **RDF Type**—RDF configuration.
   - **Geometry - Type**—Method used to define the volume's geometry.
   - **Geometry - Number of Cylinders**—Number of cylinders.
   - **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint tagged** — Indicates whether volume is tagged for RecoverPoint.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.

The following controls are available:

**Note**

Depending on the storage environment, some of the following controls may not be available.

- **Create Volume** — Creating DATA volumes on page 206
- **Delete** — Deleting volumes on page 217
- **Enable** — Enabling and disabling DATA volumes on page 291
- **Disable** — Enabling and disabling DATA volumes on page 291
- **Activate** — Activating and deactivating DATA volumes on page 291
- **Deactivate** — Activating and deactivating DATA volumes on page 291
- **Start Draining** — Start draining DATA volumes on page 292
- **Stop Draining** — Stop draining DATA volumes on page 292
- **Assign Dynamic Cache Partition** — Assigning dynamic cache partitions on page 234
- **Duplicate Volume** — Duplicating volumes on page 217

The Related Objects panel links you to views displaying objects contained in and associated with the DATA volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example,
clicking **Back End Paths** - 2 will open a view listing the two directors associated with the volume.

## Creating thin pools

When creating thin pools, Unisphere for VMAX works on a best effort basis, meaning that it attempts to satisfy as much as possible of the requested pool from existing DATA volumes, and then creates the volumes necessary to meet any shortfall.

**Before you begin:**

Thin pools contain DATA volumes of the same emulation and the same configuration. When creating thin pools, will attempt to instill best practices in the creation process by updating the default Protection level according to the selected Disk Technology:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Default protection level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFD</td>
<td>RAID5(3+1)</td>
</tr>
<tr>
<td>FC</td>
<td>2-Way Mirror</td>
</tr>
<tr>
<td>SATA</td>
<td>RAID6(6+2)</td>
</tr>
</tbody>
</table>

To create a thin pool:

**Procedure**

1. Select the storage system.
2. **Storage > Thin Pools** to open the Thin Pools list view.
3. Click **Create Thin Pool** > Thin Pools to open the Create Thin Pool dialog box. When this dialog box first opens, the chart displays the configured and unconfigured space on the selected storage system. Once you select a disk technology later in this procedure, and therefore a disk group, this chart will display the configured and unconfigured space of the selected group.
4. Type the **Pool Name**. Thin pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore ( _ ); however, the name cannot start or end with an underscore.
5. Select the **Disk Technology** on which the pool will reside.
6. Select the **RAID Protection** level for the DATA volumes to use in the pool.
7. Select an **Emulation** type for the pool.
8. Specify the capacity that the template will find or create by doing one of the following:
   - Typing the **Number of Volumes** and selecting the capacity for each volume (**Volume Capacity**).
   - Selecting the **Volume Capacity**.
9. Click one of the following:
   - **OK** to review your selections and ultimately create the pool.
   - **Show Advanced** to continue setting the advanced options, as described next.

**Setting Advanced options:**
a. Select the Disk Group containing the DATA volumes to use in the pool.

b. To specify the percentage of the pool's capacity to enable, select Enable Max Subscription (0-65534) and type a percentage.

c. Type the Rebalancing Variance (1-50). This is the target volume utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level data distribution in a pool so that the percentage utilization of any volume in the pool is within the target variance of the percentage utilization of any other volume in the pool. Possible values range from 1 to 50%, with the default value being 1%. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.

d. Type the Maximum Rebalancing Scan Device Range (2-1024). This is the maximum number of volumes in the pool on which the rebalancing algorithm will concurrently operate. Possible values range from 2 to 1024, with the default value being 256. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.

e. To specify the percentage of the capacity of the thin pool that will be reserved for non-FAST activities, select Pool Reserved Capacity (1-80) and type a value. If the free space in the pool (as a percentage of pool-enabled capacity) falls below this value, the FAST controller does not move any more chunks into the pool. Specifying a value here will override the system-wide PRC value. Possible values range from 1 to 80.

f. To enable the DATA volumes in the pool for use, select Enable DATA Volume for Use.

g. To enable FAST VP compression for the volumes in a thin pool, select Enable VP Compression. This feature maximizes the storage capacity usage within the pool by compressing its volumes.

h. Click OK.

i. Verify your selections in the Create Thin Pool - Summary page, and do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List and click Run Now to create the pool now.

Expanding thin pools

Before you begin

Unisphere for VMAX supports best practices, which state that volumes from different drive technologies should not be mixed in the same thin pool. To this end, Unisphere for VMAX will only expand a thin pool with volumes from the same disk group as the volumes already in the pool. This is an important distinction from Solutions Enabler, which does not impose this restriction.

Expanding thin pools refers to the process of increasing the amount of pool storage accessible to a thin volume by either adding a predefined capacity to the pool, or by increasing the pool's capacity by a percentage.

To expand a thin pool:

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click Expand to open the Expand Thin Pool dialog box. The chart on this dialog box displays the configured and unconfigured space of the disk group containing the pool’s DATA volumes.
4. Select how to expand the pool, either by Capacity or Percentage:
   - **Capacity**—The Volume Capacity field defaults to the first data volume size in the pool. All volume sizes contained in the pool are available. Type the Extra Pool Capacity and select the unit of capacity.
   - **Percentage**—Type an amount in the Percentage Increase field.
5. Optional: Click Show Advanced and complete the following steps:
   - Select Volume Capacity, in GB.
   - Click Start Write Balancing to enable write balancing.
6. Click OK.
7. Verify your selections in the Expand Thin Pool - Summary page, and click Add to Job List or Run Now.

**Draining thin pools**

This procedure explains how to re-balance data across all the DATA volumes in a thin pool. This procedure is typically performed after expanding a thin pool.

Before you begin:
- The drain operation is not supported with any ongoing replication operation.
- You can only drain deactivated DATA volumes. For instructions, refer to Activating and deactivating DATA volumes on page 291.
- The drain must not cause the enabled volumes to end up with greater than 90% utilization in the pool. To calculate this, adds the total used tracks on the enabled volumes and the total used tracks on the volumes that will be drained and divides this sum by the total number of tracks on all the enabled volumes. If the result is greater than 90% the drain request is blocked.
- The number of volumes that are draining at any time are limited to 20% total of the number of volumes to drain (or draining) plus the number of enabled volumes. This limits the impact on the system.
- This feature is only supported on Symmetrix DMX systems running Enginuity 5773.150 or higher.

To drain thin pools:

**Procedure**

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open its Details view.
4. In the Related Objects panel, click DATA Volumes to open the DATA Volumes list view.
5. Select one or more volumes, click more, and select Start Draining.
6. Click OK.

This will put the volumes in a Draining state.
7. Monitor the draining until it reaches an acceptable percentage. This will require you to refresh the view. If you do not monitor the draining, eventually all data will be drained from the volumes and they will go into a Disable state.

8. When a volume reaches an acceptable level, select it, click more, and select Stop Draining.

9. Click OK in the confirmation dialog. This will put the volume in an Enabled state.

10. If you are draining multiple devices, repeat steps 8-10 until all the volumes are drained to an acceptable percentage.

For more information about thin pools and thin provisioning concepts, refer to the VMAX Product Guide.

Starting and stopping thin pool write balancing

Before you begin

- You can only perform this procedure on an enabled thin pool with at least one thin volume bound to it.
- While write balancing is going on, all pool operations can still occur.
- Write balancing requires Enginuity 5876 or higher.

Write balancing thin pools refers to the process of rebalancing allocated capacity across all the DATA volumes in the pool. This procedure is typically performed after expanding a thin pool.

To write balance a thin pool:

Procedure

1. Select the storage system
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open the thin pool's details view.
4. Start write balancing by clicking more, and selecting Start Write Balancing.
5. Click OK in the confirmation message. This will put the pool in a Balancing state.
6. Monitor the balancing until it reaches an acceptable percentage
7. Select the thin pool, click more, and select Stop Write Balancing.

Deleting thin pools

Before you begin:

You can only delete empty thin pools. For instructions, refer to Adding/Removing thin pool members on page 300.

To delete a thin pool:

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click Delete.
4. Click Delete.
Adding/Removing thin pool members

This procedure explains how to add/remove members from a thin pool.

Before you begin:

- The Symmetrix system must be running Enginuity 5773 or 5876.
- Before you can remove a thin pool member (DATA volume), you must first disable it.
- Unisphere for VMAX supports best practices, which state that volumes from different drive technologies should not be mixed in the same thin pool. To this end, the Add Volumes to Thin Pool dialog box will only allow you to add volumes from the same disk group as the volumes already in the pool. This is an important distinction from Solutions Enabler, which does not impose this restriction.

To add/remove thin pool members:

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open the thin pool's details view.
4. In Related Objects, click DATA Volumes to open the DATA Volumes view.
5. Do the following, depending on whether you are adding or removing volumes from the pool:
   - Adding volumes:
     a. Click Add Volumes to Pool to open the Add Volumes to Thin Pool wizard.
     b. Locate the volumes by selecting/typing values for any number of the following criteria:
        - Capacity equal to — Filters the list for volumes with a specific capacity.
        - Volume ID — Filters the list for a volume with specific ID.
        - Volume Identifier Name — Filters the list for the specified volume name.
     c. Click Find Volumes to run the query now, or specify Additional Criteria to add conditional expressions to your query, as described next.
        a. Select values for the following:
           - Category — Specifies the broad category.
           - Attribute — Refines the category.
           - Operator — Establishes the relationship between the attribute and the value.
           - Value — Conditions for the specified attribute.
        b. Click Add Another and repeat the previous step for each additional expression.
        c. Click Find Volumes.
        d. In the Available Volumes table, select the volumes.
Enabling and disabling thin pool members

Procedure
1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open the thin pool's details view.
4. In Related Objects, click DATA Volumes to open the DATA Volumes for Thin Pool view.
5. Do one of the following:
   - To enable members, select them and click Enable.
   - To disable members, select them and click Disable.
6. Click OK.

Managing thin pool allocations

Before you begin
- You can only allocate thin pool capacity to bound thin volumes.
- Thin pool allocation for individual thin volumes requires Enginuity 5773 or 5876, or HYPERMAX OS 5977 or higher.
- Thin pool allocation for thin volumes in a storage group requires Enginuity 5876, or HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the Volumes view. You can also perform this procedure from storage group views. Depending from where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop allocating thin pool capacity from the Volumes view. In addition, you can also perform this operation from the following views:
- Storage Groups (HYPERMAX OS 5977 or higher): Storage > Storage Groups Dashboard > Storage Groups
- Storage Groups (Enginuity 5876): Storage > Storage Groups
- Device Groups: Data Protection > Replication Groups and Pools > Device Groups
- File Storage Groups: System > System Dashboard > File Dashboard > File Storage Groups

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For
information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204, respectively.

4. Do one of the following:
   - To start thin pool allocation:
     - Select one or more volumes, click more and select Start Allocate/Free/Reclaim to open the Start Allocate/Free/Reclaim dialog box.
     - Select Allocate Volumes. In addition, on storage systems running Enginuity 5876 or HYPERMAX OS 5977 or higher, you can optionally specify to persist preallocated capacity on the thin volumes by selecting the Persist preallocated capacity through reclaim or copy option. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
     - To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
   - To stop thin pool allocation:
     - Select one or more volumes, click more and select Stop Allocate/Free/Reclaim to open the Stop Allocate/Free/Reclaim dialog box.
     - Select Stop Allocate.
     - To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

For more information about thin pools and thin provisioning concepts, refer to the VMAX Product Guide.

Managing space reclamation

Before you begin
- You can only reclaim thin pool capacity from bound thin volumes.
- Thin pool reclamation for individual thin volumes requires Enginuity 5876 or HYPERMAX OS 5977 or higher.
- Thin pool reclamation for thin volumes in a storage group requires Enginuity 5876 or higher.
- This procedure explains how to perform this operation from the Volumes view. You can also perform this operation from storage group views. Depending from
where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop the space reclamation option, freeing unused pool capacity and reclaiming unwritten tracks from thins volumes. In addition, you can also perform this operation from the following views:

- **Storage Groups (HYPERMAX OS 5977 or higher):** Storage > Storage Groups Dashboard > Storage Groups
- **Storage Groups (Enginuity 5876):** Storage > Storage Groups
- **Device Groups:** Data Protection > Replication Groups and Pools > Device Groups
- **File Storage Groups:** System > System Dashboard > File Dashboard > File Storage Groups

For more information about thin pools and thin provisioning concepts, refer to the VMAX Product Guide.

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204, respectively.
4. Do one of the following:
   - To start space reclamation:
     - Select one or more volumes, click more, and select **Start Allocate/Free/Reclaim** to open the Start Allocate/Free/Reclaim dialog box.
     - To start reclaiming unwritten tracks and those written completely with zeros, select **Reclaim Volumes**. This option is only available on storage systems running Enginuity 5876 or higher, or storage systems running HYPERMAX OS 5977 or higher.
     - Optional: To reclaim tracks that are unwritten or zero-based, even if they are marked as persistent, select **Reclaim persistent capacity**.
     - To reserve the volumes, select **Reserve**. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
   - To stop space reclamation:
     - Select one or more volumes, click more, and select **Stop Allocate/Free/Reclaim** to open the Stop Allocate/Free/Reclaim dialog box.
     - Select **Stop Reclaim**. In addition, on storage systems running Enginuity 5876, you can optionally specify to free tracks that are unwritten or zero-based, even if they are marked persistent.
To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Managing thin pool capacity

Before you begin
   - You can only reclaim thin pool capacity from bound thin volumes.
   - Thin pool reclamation for individual thin volumes requires Enginuity 5876 or HYPERMAX OS 5977 or higher.
   - This procedure explains how to perform this operation from the Volumes view. You can also perform this operation from storage group views. Depending from where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop the process of freeing allocated thin pool capacity from the Volumes view. In addition, you can also perform this operation from the following views:

- Storage Groups (HYPERMAX OS 5977 or higher): Storage > Storage Groups
  Dashboard > Storage Groups
- Storage Groups (Enginuity 5876): Storage > Storage Groups
- Device Groups: Data Protection > Replication Groups and Pools > Device Groups
- File Storage Groups: System > System Dashboard > File Dashboard > File Storage Groups

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher), or the tree menu in the Volumes dashboard (Enginuity 5773 or 5876). For information on using these components, refer to Managing volumes (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes (Enginuity 5773 or 5876) on page 204, respectively.
4. Do one of the following:
   - To start freeing unused capacity:
     - Select one or more volumes, click more, and select Start Allocate/Free/Reclaim to open the Start Allocate/Free/Reclaim dialog box.
     - Select Free Volumes.
Optional: To free all allocations associated with the volumes, regardless of whether the data is written, select **Free all allocations (written and unwritten)**. This option is only available on storage systems running HYPERMAX OS 5977 or higher.

To reserve the volumes, select **Reserve**. In addition you can also type reserve **Comments** and select an **Expiration Date**. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

To stop freeing unused capacity:

- Select one or more volumes, click more ▶, and select **Stop Allocate/Free/Reclaim** to open the Stop Allocate/Free/Reclaim dialog box.
- Select **Free Volumes**. In addition, on storage systems running Enginuity 5876, you can optionally specify to free tracks that are unwritten or zero-based, even if they are marked persistent. This option is only available on storage systems running Enginuity 5876.
- To reserve the volumes, select **Reserve**. In addition you can also type reserve **Comments** and select an **Expiration Date**. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

5. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

For more information about thin pools and thin provisioning concepts, refer to the *Solutions Enabler Symmetrix Array Management CLI Product Guide*.

**Viewing thin pools**

**Procedure**

1. Select the storage system.
2. Select **Storage > Thin Pools** to open the Thin Pools list view.
3. The **Thin Pools** list view allows you to view and manage thin pools on a storage system.

   The following properties display:

   - **Name** — Name of the thin pool.
   - **Technology** — Disk technology on which the pool resides.
   - **Configuration** — Configuration of the pool.
   - **Emulation** — Emulation of the pool.
   - **Allocated Capacity** — Percentage of the pool that is allocated.
   - **Enabled Capacity (GB)** — Capacity of the pool in GB.

   The following controls are available:
Viewing thin pool details

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the pool and click View Details to open its Details view.
4. The thin pool Details view allows you to display and manage a thin pool. It contains Properties, Related Objects, Performance, and Graphs panels.

The following properties display:

- **Name** — Name of the pool. To rename a pool, type a new name over the existing and click Apply. Thin pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore (_); however, the name cannot start or end with an underscore.
- **RAID Protection** — RAID protection level for the DATA volumes in the pool.
- **Type** — The pool type.
- **Technology** — Disk technology on which the pool resides.
- **Disk Location** — Whether the disk group is Internal to the storage system or an External storage system or storage device.
- **Emulation** — Emulation type for the pool.
- **Total Capacity (GB)** — Total capacity of the pool.
- **Free Capacity (GB)** — Free capacity in the pool.
- **Thin Volumes** — Number of thin volumes bound to the pool.
- **Enabled Volumes** — Number of enabled DATA volumes in the pool.
- **Disabled Volumes** — Number of disabled DATA volumes in the pool.
- **% Allocated** — Percent of pool used.
- **Set Maximum Subscription** — Enable oversubscription for the pool.
- **Maximum Subscription (0-65534)** — Acceptable oversubscription ratio for the pool.
- **% Subscription** — Current subscription percentage.
- **Enabled Capacity (GB)** — Sum of capacity of all enabled DATA volumes in the pool.
- **Allocated Capacity (GB)** — Pool capacity allocated to thin volumes.
- **State** — Pool state (Enabled, Disable, Balancing).
- **Rebalance Variance (0-50)** — Target volume utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level data distribution in a pool so that the percentage utilization of any volume in the pool is within the target variance of the percentage utilization of any other volume in the pool. Possible values range from 1 to 50%, with the default
value being 1%. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.

- **Maximum Volumes per Rebalance Scan** — Maximum number of volumes in the pool on which the rebalancing algorithm will concurrently operate. To change this number, type a new value over the existing and click Apply. Possible values range from 1 to 1024, with the default value being 256. This field only applies to thin pool on a Symmetrix system running Enginuity 5876 or higher.

- **Pool Reserved Capacity Enabled** — Whether a percentage of the capacity of the thin pool is reserved.

- **Pool Reserved Capacity** — The percentage of the capacity of the thin pool that will be reserved for non-FAST activities.

- **Pool Egress Counter** — Number of track groups freed from the thin pool as a result of a FAST related data movement.

- **Pool Ingress Counter** — Number of track groups allocated in the thin pool as a result of a FAST related data movement.

- **Enable VP Pool Compression** — Enables (when selected) or disables (when cleared) VP pool compression for the pool. VP pool compression compresses data on the volumes in the pool to save space. VP Pool compression is available for thin pools only not Snap or DSE pool types. VP compression cannot be enabled on a thin pool of encapsulated volumes.

- **Saved By Compression (Tracks)** — The number of tracks saved by using VP Pool Compression.

- **Pool Compression Ratio (%)** — Percentage of allocated pool capacity that is compressed.

The following controls are available:

- **Expand** — Expanding thin pools on page 297

- **Bind** — Binding/Unbinding/Rebinding thin volumes on page 315

- **Stop Write Balancing** — Starting and stopping thin pool write balancing on page 299

- **Start Write Balancing** — Starting and stopping thin pool write balancing on page 299

- **Apply** — Applies changes made in the Properties list. For example, renaming the thin pool.

- **Cancel** — Cancels changes made in the Properties list.

The Related Objects panel links you to views displaying objects contained in and associated with the thin pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking DATA Volumes - 2 will open a view listing the two DATA volumes in the pool.

The Performance panel links you to the performance monitor and analyze views for the thin pool.

This panel only displays when the Performance option is installed. This panel will display with inactive links if the selected storage system is not registered for data collection.

The Graphs panel provides a graphic representation of the thin pool’s allocation as a percentage.
Viewing bound volumes for a thin pool

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the pool and click View Details to open its Details view.
4. In the Related Object panel, click Bound Volumes to open the Bound Volumes for Thin Pool list view.
5. Use the Bound Volumes for Thin Pool list view to view and manage the thin volumes bound to a thin pool.

The following properties display:

- **Name**—Assigned volume name.
- **Configuration**—Volume configuration.
- **Emulation**—Emulation type for the volume.
- **Volume Allocation by Pool**—Percentage of pool allocated to the thin volume.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Pool Allocation (GB)**—Number of GBs from the pool allocated for exclusive use by the volume.
- **Total Subscribed %**—Ratio between the pool's enabled capacity and the thin volumes subscribed capacity.
- **Total Written (GB)**—Number of allocated GBs in the pool that the thin volume has actually used.
- **Shared Tracks**—Whether the volume shares tracks with other thin volumes.
- **Persistent Allocation**—Whether allocations on the thin volume are persistent.
- **Status**—Volume status.

The following controls display:

- **Create**—Creating thin volumes (Enginuity 5773 or 5876) on page 212
- **View Details**—Viewing thin volume details on page 270
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 315
- **VLUN Migration**—VLUN Migration dialog box on page 321
- **Unpin**—Pinning and unpinning volumes on page 192
- **Pin**—Pinning and unpinning volumes on page 192
- **Unmap**—Unmapping volumes on page 222
- **Map**—Mapping volumes on page 221
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896
- **Stop Allocate/Free/Reclaim**—Stop Allocate/Free/Reclaim dialog box on page 313
Viewing DATA volumes for a thin pool

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open its Details view.
4. In the Related Objects panel, click DATA volumes to open the DATA volumes for Thin Pool list view.
5. Use the DATA volumes for Thin Pool list view to display and manage the DATA volumes in a thin pool.

The following properties display:

- **Name**—Name of the DATA volume.
- **Emulation**—Volume emulation.
- **Configuration**—Volume configuration.
- **Used (%)**—Percent of the volume used.
- **Used (GB)**—Space used.
- **Free**—Free space on the volume.
- **Status**—Volume status.
- **Session Status**—Session status (Active, or Inactive).

The following controls are available:

- **Create**—Creating DATA volumes on page 206
- **View Details**—Viewing details on DATA volumes in thin pools on page 310
- **Add Volumes to Pool**—Adding/Removing thin pool members on page 300
- **Remove**—Adding/Removing thin pool members on page 300
- **Enable**—Enabling and disabling thin pool members on page 301
- **Disable**—Enabling and disabling thin pool members on page 301
- **Stop Draining**—Draining thin pools on page 298
- **Start Draining**—Draining thin pools on page 298
Activate—Activating and deactivating DATA volumes on page 291
Deactivate—Activating and deactivating DATA volumes on page 291

Viewing details on DATA volumes in thin pools

Procedure
1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click View Details to open its Details view.
4. In the Related Objects panel, click DATA volumes to open the DATA volumes for Thin Pool list view.
5. Select a DATA volume and click View Details to open its Details view.
6. Use the DATA Volumes for Thin Pool Details view to display and manage a thin pool member. This view contains two panels: Properties and Related Objects

The following properties display:
- **Name**—Volume name.
- **Type**—Volume configuration.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinders)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **SSID**—Subsystem ID.
- **Capacity (Tracks)**—Capacity in tracks.
- **SA Status**—Volume SA status.
- **Host Access Mode**—Host access mode.
- **Pinned**—Whether the volume is pinned.
- **Service State**—Service state.
- **Defined Label Type**—Type of user-defined label.
- **Dynamic RDF Capability**—RDF capability of the volume.
- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status**—Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name**—Name of the cache partition.
- **Host Cache Attached**—Whether volume is attached to host cache.
- **Compression Delta**—Difference between volume allocation and uncompressed data.

The following controls are available:
- **Create**—Creating DATA volumes on page 206
- **Add Volumes to Pool**—Adding/Removing thin pool members on page 300
- **Remove**—Adding/Removing thin pool members on page 300
- **Enable**—Enabling and disabling thin pool members on page 301
- **Disable**—Enabling and disabling thin pool members on page 301
- **Stop Draining**—Draining thin pools on page 298
- **Start Draining**—Draining thin pools on page 298
- **Activate**—Activating and deactivating DATA volumes on page 291
- **Deactivate**—Activating and deactivating DATA volumes on page 291

The Related Objects panel links you to views displaying objects contained in and associated with the DATA volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Back End Paths-2 will open a view listing the two directors associated with the volume.
Viewing other volumes for thin pools

Procedure

1. Select the storage system.
2. Select Storage > Thin Pools.
3. Select the pool and click View Details.
4. In the Related Object panel, click Other Volumes.
5. Use the Other Volumes for Thin Pool list view to display and manage other volumes bound to a thin pool.

The following properties display:

- **Name** — Assigned volume name.
- **Pool Name** — Pool to which the volume is bound.
- **% Allocated** — Percentage of space allocated in the pool.
- **Allocated Capacity** — Amount of space allocated in the pool.

The following controls are available:

- **Create** — Creating thin volumes (Enginuity 5773 or 5876) on page 212
- **View Details** — Viewing thin volume details on page 270
- **Bind** — Binding/Unbinding/Rebinding thin volumes on page 315
- **Unbind** — Binding/Unbinding/Rebinding thin volumes on page 315
- **Untag for Recover Point** — Tagging and untagging volumes for Recoverpoint (volume level) on page 584
- **Tag for Recover Point** — Tagging and untagging volumes for Recoverpoint (volume level) on page 584
- **Unpin** — Pinning and unpinning volumes on page 192
- **Pin** — Pinning and unpinning volumes on page 192
- **Assign Symmetrix Priority** — Assigning Symmetrix priority to individual volumes on page 218
- **Unmap** — Unmapping volumes on page 222
- **Map** — Mapping volumes on page 221
- **Assign Dynamic Cache Partition** — Assigning dynamic cache partitions on page 234
- **Stop Allocate/Free/Reclaim** — See Managing thin pool allocations on page 301 and Managing space reclamtion on page 302
- **Set Volume Status** — Setting volume status on page 223
- **Set Volume Identifiers** — Setting volume identifiers on page 225
- **Set Volume Attributes** — Setting volume attributes on page 224
- **Change Volume Configuration** — Changing volume configuration on page 219
- **Rebind** — Binding/Unbinding/Rebinding thin volumes on page 315
Creating or Expanding the thin pool summary dialog box

Use this dialog box to view how is going to create/expand the pool (that is, the number of existing volumes and the number of new volumes), and then ultimately do one of the following:

- Click **Add to Job List** to create/expand the pool at a later time, as described in Scheduling jobs on page 873, or from the job list as described in Viewing the job list on page 876.
- Click **Expand Add to Job List** and click **Run Now** to create/expand the pool now.
- Click **Cancel** to cancel the operation.

Start Allocate/Free/Reclaim dialog box

Use this dialog box to perform the following operations:

- Start allocating thin pool capacity for thin volumes, as described in Managing thin pool allocations on page 301.
- Start freeing unused allocated thin pool capacity, as described in Managing thin pool capacity on page 304.
- Start reclaiming unwritten tracks from thin volumes, as described in Managing space reclamation on page 302.

Stop Allocate/Free/Reclaim dialog box

Use this dialog box to perform the following operations:

- Stop allocating thin pool capacity for thin volumes, as described in Managing thin pool allocations on page 301.
- Stop freeing unused allocated thin pool capacity, as described in Managing thin pool capacity on page 304.
- Stop reclaiming unwritten tracks from thin volumes, as described in Managing space reclamation on page 302.

Creating thin volumes (Enginuity 5773 or 5876)

This procedure explains how to create thin volumes on storage systems running Enginuity version 5773 or 5876. For instructions on creating thin volumes on storage systems running HYPERMAX OS 5977 or higher, refer to Creating thin volumes (HYPERMAX OS 5977) on page 213.

Procedure

1. Select the storage system.
2. Hover the cursor over the **Storage** menu and select **Create Volumes** under **Common Tasks** to open the **Create Volume** dialog box.
3. In **Volume Type**, click **Virtual**.
4. Select **Configuration** (TDEV or BCV + TDEV) or thin volumes.
5. Select the **Emulation** type.
6. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
7. To bind the new volumes to a specific thin pool, select one from **Bind to Pool**. Only thin pools with enabled DATA volumes and matching emulation are available for binding (except AS/400 which will bind to an FBA pool).

8. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

   **Setting Advanced options:**
   
   a. To name the new volumes, select one of the following **Volume Identifiers** and type a **Name**:
      - **None** — Allows the system to name the volumes (Default).
      - **Name Only** — All volumes will have the same name.
      - **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
      - **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

   For more information on naming volumes, refer to **Setting volume names** on page 226.

   b. To **Allocate Full Volume Capacity**, select the option.

   c. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

   d. To assign **Dynamic Capability** to the volumes, select one of the following; otherwise, leave this field set to **None**.
      - **RDF1_Capable** — Creates a dynamic R1 RDF volume.
      - **RDF2_Capable** — Creates a dynamic R2 RDF volume.
      - **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

   e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:
      - **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
      - **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

   f. Do one of the following:
      - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more
information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

- Expand Add to Job List, and click Run Now to perform the operation now.

Binding/Unbinding/Rebinding thin volumes

Before you begin

- Only one bind, unbind, or rebinding operation can be performed on the same volume in any one config session.

- To bind/unbind thin volumes from the group level, requires Enginuity 5876 or higher.

- As an alternative to unmapping/unmasking a volume prior to unbinding, you can make the volume Not Ready.

- A thin volume cannot be unbound from a pool if any of the following are true:
  - Volume is mapped to a front-end port or is in the Ready state
  - Volume is masked by VCM
  - Volume has active snap sessions
  - Volume is held
  - Volume is a source or target of a clone (src or tgt) session
  - Volume is a metamember
  - Volume is a part of enabled RDF CG group
  - Volume is an RDF volume

- The following apply just to the rebinding operation:
  - The thin volume has to be in the Bound state.
  - The new binding has to comply with the oversubscription ratio of the new pool. The entire size of the volume being rebound will be considered when calculating the oversubscription.
  - If volumes in a range, device group, or storage group are bound to different pools, then all the volumes will be rebound to the specified pool.
  - If a thin volume is part of a storage group that is under FAST management, the thin volume can only be bound to a pool in a tier that is part of the FAST policy associated with the storage group. Therefore, the volume can only be rebound to a pool that is within the policy.
  - If all the volumes that are being rebound are already bound to the destination pool, an error returns. If some volumes get bound to a pool different than what they are currently bound to, the operation will return a success status.

- For more information about thin pools and thin provisioning concepts, refer to the Solutions Enabler Array Management CLI Product Guide.

This procedure explains how to bind/unbind/rebind thin volumes to a thin pool of DATA volumes.

You can bind/unbind/rebind thin volumes at the volume, pool, or storage group level.

Procedure

1. Do one of the following:
   - To bind/unbind/rebind thin volumes at the volume level:
a. Select the storage system.
b. Select Storage > Volumes to open the Volume Dashboard.
c. In the Volume Type panel, select the type of volume to bind/unbind.
d. Click View to open the volume list view.
e. Do the following, depending on whether you are binding or unbinding thin volumes:
   a. Binding: Select one or more volumes and click Bind to open the Bind Thin Volumes dialog box.
   b. From Pool Name, select the thin pool with which to bind the volume.
   c. Optional: Specify to Allocate Full Volume capacity.
   d. To view additional information on the selected volumes, click Show selected volumes.
   e. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
   f. Click OK.

a. Unbinding: Select one or more volumes and click Unbind to open the Unbind Thin Volumes dialog box.
b. To view additional information on the selected volumes, click Show selected volumes.
c. Click OK.
   a. Rebinding: Select one or more volumes, click more and select Rebind to open the Rebind Thin Volumes dialog box.
   b. Select the Pool Name with which to rebind the volumes.
   c. To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date.
   d. Click OK.

- To bind/unbind/rebind thin volumes at the pool level:
  a. Select the storage system.
  b. Select Storage > Thin Pools to open the Thin Pools list view.
  c. Select the thin pool and click View Details to open the thin pool's details view.
  d. Do the following, depending on whether you are binding or unbinding volumes:
     a. Binding: Click Bind to open the Bind Thin Volumes wizard.
     b. Locate the volumes by selecting/typing values for any number of the following criteria:
        ▪ Capacity equal to — Filters the list for volumes with a specific capacity.
        ▪ Volume ID — Filters the list for a volume with specific ID.
        ▪ Volume Identifier Name — Filters the list for the specified volume name.
- Additional Criteria — Allows you to add conditional expressions to your query, as describe next:
  a. Select values for the following:
     - Category — Specifies the broad category.
     - Attribute — Refines the category.
     - Operator — Establishes the relationship between the attribute and the value.
     - Value — Conditions for the specified attribute.
  b. To add another expression, click Add Another, and repeat the previous step. To clear your criteria, click Clear All.
  c. Click Find Volumes to run the query. Results are displayed on the next page in the wizard.
  d. Optional: To modify your query, click Modify Criteria and repeat steps 5 and 6; otherwise continue with the remaining steps in this procedure.
  e. Select the volumes.
  f. Optional: Specify to Allocate Full Volume capacity, and then whether to mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
  g. Click Bind.
  a. Unbinding: In Related Objects, click Bound Volumes to open the Bound Volumes detail view.
  b. Select one or more volumes and click Unbind.
  c. Click OK in the confirmation message.
  a. Rebinding: Select one or more volumes, click more ▶, and select Rebind to open the Rebind thin volumes dialog box.
  b. Select the Pool Name with which to rebind the volumes.
  c. Click OK.
- To bind/unbind/rebind thin volumes at the storage group level:
  a. Select the storage system.
  b. Select Storage > Storage Groups to open the Storage Groups list view.
  c. Do the following, depending on whether you are binding or unbinding thin volumes:
    a. Binding: Select the storage group, click more ▶, and select Bind SG to open its Bind Thin Volumes dialog box.
    b. From Pool Name, select the thin pool with which to bind the volume.
    c. Optional: Specify to Allocate Full Volume capacity, and then whether to mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
    d. Click OK.
a. Unbinding: Select the storage group, click more, and select Unbind SG to open its Unbind Thin Volumes dialog box.
b. To view additional information on the selected volumes, click Show selected volumes.
c. Click OK.

a. Rebinding: Select the storage group, click more, and select Rebind SG to open the Rebind Thin Volumes dialog box.
b. Select the Pool Name with which to rebind the volumes.
c. Click OK.

Understanding Virtual LUN Migration

Virtual LUN Migration (VLUN Migration) enables transparent, nondisruptive data mobility for both disk group provisioned and virtually provisioned Symmetrix system volumes between storage tiers and between RAID protection schemes. Virtual LUN can be used to populate newly added drives or move volumes between high performance and high capacity drives, thereby delivering tiered storage capabilities within a single Symmetrix system. Migrations are performed while providing constant data availability and protection.

Note

Virtual LUN migration requires Enginuity 5876.

Virtual LUN Migration performs tiered storage migration by moving data from one RAID group to another, or from one thin pool to another. It is also fully interoperable with all other Symmetrix system replication technologies such as SRDF, TimeFinder/Clone, TimeFinder/Snap, and Open Replicator.

RAID Virtual Architecture allows, for the purposes of migration, two distinct RAID groups, of different types or on different storage tiers, to be associated with a logical volume. In this way, Virtual LUN allows for the migration of data from one protection scheme to another, for example RAID 1 to RAID 5, without interruption to the host or application accessing data on the Symmetrix system volume.

Virtual LUN Migration can be used to migrate regular Symmetrix system volumes and metavolumes of any emulation — FBA, CKD, and IBM i series. Migrations can be performed between all drive types including high-performance enterprise Flash drives, Fibre Channel drives, and large capacity SATA drives.

Migration sessions can be volume migrations to configured and unconfigured space, or migration of thin volumes to another thin pool.

Migrating regular storage group volumes

Before you begin

- Virtual LUN migration requires Enginuity 5876.
- To migrate volumes when access control is enabled, you must grant Symmetrix Optimizer access rights to the volumes.

This procedure explains how to migrate all the regular volumes in a storage group.

To migrate regular storage group volumes:
Procedure

1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups view.
3. Select a storage group, click more ▶, and select VLUN Migration to open the VLUN Migration dialog box.
4. Type a Migration session name. Migration session names must be less than 32 characters long and are case sensitive.
5. Select a Migration Type. Available options are Disk Group and Virtual Pool.
6. Select a Target Disk Group.
7. Select the RAID Protection type.
8. Select Target type. Choose Create new volumes to migrate to unconfigured volumes or Use existing volumes to migrate to configured volumes.
9. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.
10. Click OK to create the migration session.

Migrating regular volumes

Before you begin

- Virtual LUN migration requires Enginuity 5876.
- To migrate volumes when access control is enabled, you must grant Symmetrix Optimizer access rights to the volumes.

This procedure explains how to migrate individual regular volumes.

To migrate regular volumes:

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes view.
3. Expand the Regular Volumes folder, select the desired Volume Type, and click View to open the volume list.
4. Select one or more volumes, click more ▶, and select VLUN Migration to open the VLUN Migration dialog box.
5. Type a Migration session name. Migration session names must be less than 32 characters long and are case sensitive.
6. Select a Target Disk Group.
7. Select the RAID Protection type.
8. Select the Target type. Choose Create new volumes to migrate to unconfigured volumes or Use existing volumes to migrate to configured volumes.
9. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.
10. Click OK.
Migrating thin storage group volumes

Before you begin

- Virtual LUN migration requires Enginuity 5876.
- To migrate volumes when access controls is enabled, you must grant Symmetrix Optimizer access rights to the volumes.
- For instructions on migrating volumes on Symmetrix systems running Enginuity levels lower than 5876, see Migrating regular volumes on page 319.

This procedure explains how to migrate all the thin volumes in a storage group.

To migrate thin storage group volumes:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups to open the Storage Groups view.
3. Select a storage group, click more, and select VLUN Migration to open the VLUN Migration dialog box.
4. Type a Migration session name. Migration session names must be less than 32 characters and are case sensitive.
5. Select a Target Pool.
6. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.
7. Optional: Expand Show Advanced. From the Migrate allocations from pool menu, select a pool from which to migrate allocations.
8. Click OK.

Migrating thin volumes

Before you begin

- Virtual LUN migration requires Enginuity 5876.
- To migrate volumes when access controls is enabled, you must grant Symmetrix Optimizer access rights to the volumes.

This procedure explains how to migrate individual thin volumes.

To migrate selected thin volumes:

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes view.
3. Expand the Virtual Volumes folder, select TDEV Volume Type, and click View to open the Thin Volumes list.
4. Select one or more volumes, click more, and select VLUN Migration to open the VLUN Migration dialog box.
5. Type a Migration session name. The session name must be less than 32 characters long and is case sensitive.
6. Select a Target Pool.
7. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.

8. Optional: Expand Show Advanced. From the Migrate allocations from pool menu, select a pool from which to migrate allocations.

9. Click OK.

Terminating a VLUN migration session

Procedure

1. Select the storage system.

2. Select Data Protection > Virtual LUN Migration to open the Virtual LUN Migration sessions list view.

3. Select the migration session and click Terminate.

4. Click OK.

Viewing VLUN migration sessions

Procedure

1. Select the storage system.

2. Select Data Protection > Virtual LUN Migration to open the Virtual LUN Migration sessions list view.

   Use this view to display and manage migration sessions.
   The following properties display:
   
   - Name—Migration session name.
   - Invalid Tracks—Number of invalid tracks for the volume pair.
   - Status—Migration session status.
   - Percentage—Percentage of the session completed.

   The following controls are available:

   - Terminate—Terminating a VLUN migration session on page 321
   - View Details—#unique_389

Select VLUN Migration Session Target dialog box

Use this dialog box to select the target disk group (standard migration) or target thin pool (thin migration).

VLUN Migration dialog box

From this dialog box you can perform volume migrations for regular or thin volumes. Thin volumes migrate from a source pool to a target pool, and regular volumes migrate to configured (existing) volumes or unconfigured (new) volumes.

Some of the options in the dialog box display will differ depending on whether you are migrating regular or thin volumes.

For volume-specific migration procedures, refer to the following:

- Migrating regular volumes on page 319
Working with external disks

You can perform the following operations:

- Start draining an external disk. For more information, refer to Start draining external disks on page 333.
- Stop draining an external disk. For more information, refer to Stop draining external disks on page 334.
- Activate an external disk. For more information, refer to Activating external disks on page 334.

Viewing external storage

The External Storage page allows you to view and manage external storage as well as validate paths and zoning. The first time you visit the External Storage page, Unisphere scans all of the volumes that are visible from the DX directors.

At least four paths to external volumes is required, meaning that at least four ports belonging to a single DX dual initiator pair must be configured. The best practice for maximum redundancy is achieved by using single initiator/multiple target zoning. This is accomplished by creating individual zones that contain each DX port and all external ports that the external volumes are available on.

To view external storage and validate paths and zoning:

Procedure

1. Select the storage system.
2. Select Storage > External Storage to open the External Storage page.

Use the tree view lists to filter the list of external LUNs by selecting various combinations of members within a tree list view (control ports, external ports, and external LUNs). You can select a single item, multiple items in consecutive rows (hold shift key and select), or multiple items in non-consecutive rows (hold control key and select). As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.

Control Ports tree view list

The following properties display:

- **Director**—Storage system DX director.
- **Port**—Port number on the director.

External Ports tree view list

The following properties display:

- **Port WWN**—World Wide Name of the external port.
- **Array ID**—External storage ID.
- **Vendor**—External storage system vendor.

External LUNs tree view list

The following properties display:
- **LUN WWN**—World Wide Name of the external LUN.
- **Capacity (GB)**—Capacity in GB of the external LUN.

**Filtered results table**

The following properties display:

- **External LUN WWN**—World Wide Name of the external LUN.
- **Vendor**—Vendor name of the external LUN.
- **Capacity (GB)**—Capacity in GB of the external LUN.
- **Volume**—Volume ID on the external storage system.
- **LUN**—Displays 0 for storage systems.
- **Virtualizing Status**—The mode of operation that the eDisk is using.
  Possible values are External, Encapsulated, and None.
- **Emulation**—Emulation type of the external LUN.
- **Disk Group**—Disk group that contains the virtualized LUN.
- **Spindle**—Spindle ID of the external spindle.
- **Service State**—Availability of the external LUN. Possible values are Normal, Degraded, and Failed. Failed means that there are no network paths available to the external LUN. Degraded means that there are paths from only one of the supporting DX directors. Normal means that there are network paths available from both supporting DX directors.

The following controls are available:

- **Virtualize**—Virtualizing external LUNs on page 325 (Only displays for Enginuity 5876)
- **Rescan**—Rescanning external storage on page 323
- **Remove**—Removing external LUNs on page 330 (Only displays for HYPERMAX OS 5977 or higher)

### Rescanning external storage

The first time you visit the External Storage page, Unisphere for VMAX scans all of the volumes that are visible from the DX directors. When you return to the page, Unisphere for VMAX populates the list views with cached data.

**Procedure**

1. To rescan external storage:
   1. Select the storage system.
   2. Select **Storage > External Storage** to open the **External Storage** page.
   3. Click **Rescan** to rescan the volumes that are visible from the DX directors.

   Note that the **Last External Storage Updated** field below the filtered list view updates with the data and time of the most recent scan.

### Virtualizing external LUNs

When you attach external storage to a storage system, FAST.X virtualizes an external storage system’s SCSI logical units as disks called eDisks. eDisks have two modes of operation:
Encapsulation

Allows you to preserve existing data on external Symmetrix systems and access it through Symmetrix volumes. These volumes are called encapsulated volumes.

External Provisioning

Allows you to use external storage as raw capacity for new Symmetrix volumes. These volumes are called externally provisioned volumes. Existing data on the external volumes is deleted when they are externally provisioned.

The following restrictions apply to eDisks:

- Can only be unprotected volumes. The RAID protection scheme of eDisks is dependent on the external Symmetrix system.
- Cannot be AS400, CKD, or gatekeeper volumes.
- Cannot be used as VAULT, SFS, or ACLX volumes.

Encapsulation

Encapsulation has two modes of operation:

**Encapsulation for disk group provisioning (DP encapsulation)**

The eDisk is encapsulated and exported from the storage system as disk group provisioned volumes.

**Encapsulation for virtual provisioning (VP encapsulation)**

The eDisk is encapsulated and exported from the storage system as thin volumes.

In either case, Enginuity automatically creates the necessary volumes. If the eDisk is larger than the maximum volume capacity or the configured minimum auto meta capacity, Enginuity creates multiple volumes to account for the full capacity of the eDisk. These volumes are concatenated into a single concatenated meta volume to allow access to the complete volume of data available from the eDisk.

External provisioning

After you virtualize an eDisk for external provisioning, you can create volumes from the external disk group and present the storage to users. You can also use this storage to create a new FAST VP tier.

**Note**

If you use external provisioning, any data that is currently on the external volume is deleted.

Geometry of encapsulated volumes

Enginuity builds storage volumes based on the storage system cylinder size (fifteen 64 K tracks), so the capacity of storage volumes does not always match the raw capacity of the eDisk. If the capacity does not match, Enginuity sets a custom geometry on the encapsulated volume. For created meta volumes, Enginuity defines the geometry on the meta head, and only the last member can have a capacity that spans beyond the raw capacity of the eDisk.

Encapsulated volumes that have a cylinder size larger than the reported user-defined geometry are considered geometry limited. For additional details and a list of restrictions that apply to geometry-limited volumes, refer to the *Solutions Enabler Array Controls CLI Guide*.
Virtualizing external LUNs

Procedure

1. To virtualize external LUNs:
   1. Select the storage system.
   2. Select **Storage > External Storage**.
   3. (Optional) Click the **Not Virtualized** check box above the filtered list view to see a list of external LUNs that have not been virtualized.
   4. Select the external LUNs that you want to virtualize.
   5. Click **Virtualize** to open the **Virtualize External LUNs** dialog.
   6. Select an import method from the **Import Method** drop-down menu. This determines the mode of operation for the eDisk.

   **WARNING**

   *Selecting Raw Space - External Provisioning, deletes any data that is currently on the external volume.*

7. Select an external disk group from the **Disk Group** drop-down menu, or type a disk group name to create a new external disk group. Enginuity adds the virtualized external LUNs to the specified external disk group.

8. If you are using Virtual Provisioning, select an empty pool or an existing pool composed of externally provisioned data volumes from the **Thin Pool** drop-down menu. Type a pool name if you want to create a new pool.

9. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

Setting Advanced options:

   a. To override the auto meta member capacity configured on the storage system, specify the unit of measurement by selecting **GB**, **MB**, or **CYL** from the drop-down menu, and then select a capacity from the **Meta Member Capacity** drop-down menu. The Total Enabled Pool Capacity in GB is displayed.

   b. If you want all of the created storage volumes to be the same capacity, click the **Create Equal Meta Member Capacity** check box. If you do not select this check box, the meta tail is smaller than the other volumes in the meta.

   c. If you want to specify a DX director for the path to the eDisk, select a director from the **DX Director** drop-down menu.

   d. **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
External Storage page

Control Ports tree view list
The list contains:
- **Director** — Storage system DX director.
- **Port** — Port number on the director.

External Ports tree view list
The list contains:
- **Port WWN** — World Wide Name of the external port.
- **Array ID** — External storage ID.
- **Vendor** — External storage system vendor.

External LUNs tree view list
The list contains:
- **LUN WWN** — World Wide Name of the external LUN.
- **Capacity (GB)** — Capacity in GB of the external LUN.

Filtered results table
The table contains:
- **External LUN WWN** — World Wide Name of the external LUN.
- **Vendor** — Vendor name of the external LUN.
- **Capacity (GB)** — Capacity in GB of the external LUN.
- **Volume** — Volume ID on the external storage system.
- **LUN** — Displays 0 for storage systems.
- **Virtualizing Status** — The mode of operation that the eDisk is using. The values are:
  - External
  - Encapsulated
  - None
- **Emulation** — Emulation type of the external LUN.
- **Disk Group** — Disk group that contains the virtualized LUN.
- **Spindle** — Spindle ID of the external spindle.
- **Service State** — Availability of the external LUN. The values are:
  - Normal — There are network paths available from both supporting DX directors.
  - Degraded — There are paths from only one of the supporting DX directors.
  - Failed — There are no network paths available to the external LUN.

The following controls are available:
- **Virtualize** — (Only displays for Enginuity 5876)
- **Rescan** —
- **Remove** — (Only displays for HYPERMAX OS 5977 or higher)
Filtered results table

The external disks list shows the following properties:

- **External LUN WWN** — World Wide Name of the external disk.
- **Spindle** — Spindle ID of the external spindle.
- **Vendor** — Vendor name of the external disk.
- **Capacity (GB)** — Capacity in GB of the external disk.
- **Volume** — Volume ID on the external storage system.
- **Array ID** — ID of the storage system.
- **Service State** — Availability of the external disk. The values of this property are:
  - Normal — There are network paths available from both supporting DX directors.
  - Degraded — There are paths from only one of the supporting DX directors.
  - Failed — There are no network paths available to the external LUN.
- **Disk State** — The state of the disk. The values of this property are:
  - Active
  - Drained
  - Draining
  - Disabled
- **Drained** — Drain information about the disk if it is in Drained or Draining state. Otherwise it displays ",-".

In addition the following controls are available:

- Add eDisks —
- Remove —
- Start Draining —
- Stop Draining —
- Activate —

Understanding ProtectPoint

ProtectPoint™ integrates primary storage (VMAX system) with data protection storage (Data Domain system), thereby eliminating application servers from the data path. This integration reduces the cost and complexity associated with traditional backup applications while still providing the benefits of native backups.

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**Note**

TimeFinder/SnapVX operations are not supported on working ProtectPoint snapshots. TimeFinder/SnapVX operations are, however, supported to help repair failing ProtectPoint snapshots.

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Protecting storage groups using ProtectPoint

**Before you begin**

- The storage system must be running HYPERMAX OS 5977.
You must have StorageAdmin permission.

The Data Domain appliance must be connected and zoned to the storage system.

Provide the Data Domain Admin the number and size of volumes in the production storage group and request that they provide you with double the number of similar volumes (masked/visible to the storage system). For example, if the production storage group contains 10 volumes, the Data Domain Admin should provide you with the LUN numbers of 20 similar volumes.

- CKD devices are not supported by ProtectPoint.

To protect storage groups using ProtectPoint:

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the Storage Groups panel, click Total.
4. Select the storage group and click Protect to open the Protect Storage Group wizard.
5. Select Backup Using ProtectPoint.
6. Click Next.
7. Click OK.
8. Type the name of the Point In Time Copy Name and click Next.
9. Type a name for the Backup Storage Group, or leave the system-generated suggestion.
10. Select the external LUNs to add to the backup storage group and click Add to Storage Group.
    
    Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.
11. Click Next.
12. Type a name for the New Restore Storage Group, or leave the system-generated suggestion.
13. Select the external LUNs to add to the restore storage group and click Add to Storage Group.
    
    Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.
14. Click Next.
15. Verify your selections. To change any of them, click Back.
    
    Note that some changes may require you to make additional changes to your configuration.
16. Do one of the following:

   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

   - Expand Add to Job List and click Run Now to perform the operation now.
17. Once the job completes successfully, provide the following information to the Data Domain Admin:
The LUN numbers used in the backup storage group
The LUN numbers used in the restore storage group
The name of the point in time copy

Expanding ProtectPoint storage groups

Before you begin
- This feature requires HYPERMAX OS 5977 or higher.
- You must have StorageAdmin permission.
- The Data Domain appliance must be connected and zoned to the VMAX storage system.
- Provide the Data Domain Admin the number and size of volumes that you added to the production storage group and request that they provide you with double the number of similar volumes (masked/visible to the VMAX storage system). For example, if the production storage group contains 10 volumes, the Data Domain Admin should provide you with the LUN numbers of 20 similar volumes.
- CKD devices are not supported by ProtectPoint.

This procedure explains how to increase the amount of storage in a storage group protected by ProtectPoint.

To expand protected storage groups:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups dashboard.
   Opens the Storage Groups dashboard.
3. In the Storage Groups panel, click Total to open the Storage Groups list view.
4. Select the storage group, click , and click Expand ProtectPoint.
   Opens the Expand ProtectPoint wizard.
5. Select the Point In Time Copy to expand and click Next.
6. Select the external LUNs to add to the backup storage group and click Add to Group. Select the same number of external LUNs as the number of volumes added to the production storage group.
7. Click Next and select the Restore Storage Group.
8. Select the external LUNs to add to the restore storage group and click Add to Group. Select the same number of external LUNs as the number of volumes added to the production storage group.
9. Click Next and verify your selections. To change any of them, click Back. Some changes may require additional configuration changes.
10. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now.

Once the job has completed, provide the following information to the Data Domain Admin:
Removing external LUNs

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- LUNs must be virtualized.

This procedure explains how to remove external LUNs from storage groups protected with ProtectPoint. Encapsulated LUNs whose volumes are in a storage group cannot be removed.

Procedure

1. Select the storage system.
2. Select Storage > External Storage.
   Opens the External Storage page.
3. Optional: Use the tree view lists to filter the list of external LUNs by selecting various combinations of members within a tree list view (control ports, external ports, and external LUNs). Select either a single item, multiple items in consecutive rows (hold shift key and select), or multiple items in non-consecutive rows (hold control key and select). As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.
4. From the filtered results table, select one or more LUNs and click Remove.
   Opens the Remove External LUNs dialog box.
5. (Optional) To view details on the selected LUNs, click Show selected external LUNs.
6. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now.

Understanding FAST.X

FAST.X allows the seamless integration of VMAX3 Family storage systems and heterogeneous arrays. It enables LUNs on external storage to be used as raw capacity. Data services such as SRDF, TimeFinder, and Open Replicator are supported on the external device.

FAST.X requires HYPERMAX OS 5977, or higher.

For additional information on FAST.X, refer to the following documents:

- Solutions Enabler Array Management CLI Guide
- Solutions Enabler TimeFinder CLI User Guide
- VMAX3 Family Product Guide
Viewing external disks

Before you begin
The external disk list is available only for HYPERMAX OS 5977 or higher.

Note
You must refresh the external disks list to view the latest status.

Procedure
1. Do one of the following:
   - View the external disks lists using the Storage Groups Dashboard
     a. Select the storage system.
     b. Select Storage > Storage Groups Dashboard.
     c. In the Storage Resource Pools section, select the SRP.
     d. In the Reports section, click View SRP Details.
     e. In the Disk Groups section, click the disk group name. The external disks list appears.
   - View the external disk lists using the Storage Resource Pools view
     a. Select the storage system.
     c. Select the tab for the SRP.
     d. In the Disk Groups section, click the disk group name. The external disks list displays.

The following properties are displayed:
Filtered results table:
External LUN WWN
   World Wide Name of the external disk.
Spindle
   Spindle ID of the external spindle.
Vendor
   Vendor name of the external disk.
Capacity (GB)
   Capacity in GB of the external disk.
Volume
   Volume ID on the external storage system.
Array ID
   ID of the storage system.
Service State
   Availability of the external disk. Possible values are Normal, Degraded, and Failed. Failed means that there are no network paths available to the external LUN. Degraded means that there are paths from only one of the supporting DX directors. Normal means that there are network paths available from both supporting DX directors.
Disk State
The state of the disk. Valid values are Active, Drained, Draining, and Disabled.

Drained
Drain information about the disk if it is in Drained or Draining state. Otherwise it displays ".".

The following controls are available:
- Add eDisks — Adding external disks on page 332
- Remove — Removing external disks on page 333
- Start Draining — Start draining external disks on page 333
- Stop Draining — Stop draining external disks on page 334
- Activate — Activating external disks on page 334

Adding external disks

Before you begin
This action can be performed only for HYPERMAX OS 5977 or higher.

You can add an external disk to the external disk group of a storage resource pool (SRP). You can complete the action from the SRP detailed view or from the external disk list view.

When adding an external disk for storage systems running HYPERMAX OS 5977 or higher, if there is no pre-existing external disk group, it is created automatically when the external disk is added to the selected SRP. If an external disk group exists for the external array’s external LUN WWN, the external LUN WWN is added to it.

Procedure
1. To add an external disk:
   1. Select the storage system.
   2. Select Storage > Storage Groups Dashboard.
   3. In the Storage Resource Pools section, select the SRP.
   4. In the Reports section, click View SRP Details.
   5. Do one of the following:
      - Click Add eDisk.

      Note
      If the SRP is a CloudArray SRP and one or more external disks have already been added, further disks can be added only from the external disk list view.

      - In the Disk Groups panel, click the name of the disk group. In the external disk list view, click Add eDisk.

      The Add eDisks dialog box shows the available external LUN WWNs from multiple external arrays.

   6. Select the external disk to be added.
7. If you want to preserve the existing data on the external LUN, select **Incorporate eDisk data**. If you leave the **Incorporate eDisk data checkbox** cleared, the existing data on the external LUN is cleared.

8. (Optional) In the **Add Storage Group** list, select a storage group to add.
   You can filter the list by searching for a storage group by name.
   This option is available only on storage systems running HYPERMAX OS 5977 Q1 2016.

9. Do one of the following:
   • Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   • Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Removing external disks

**Before you begin**
This action can be performed only for HYPERMAX OS 5977 or higher.

You can remove an external disk from a storage resource pool (SRP) if it is in a Drained state.

**Procedure**

1. To remove an external disk:
   1. Select the storage system.
   2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
   3. In the **Storage Resource Pools** section, select the SRP from which you want to remove an external disk.
   4. In the **Reports** section, click **View SRP Details**.
   5. In the **Disk Groups** section, click the disk group name. The external disks list appears.
   6. Select the external disk that you want to remove and click **Remove**. The **Remove External LUNs** dialog appears and prompts for confirmation that you want to remove the external disk.
   7. Do one of the following:
      • Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
      • Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Start draining external disks

**Before you begin**
The storage resource pool (SRP) containing the external disk you want to drain must have sufficient free space to absorb the allocated tracks from the external disk that is being drained.

You can drain a disk only if it is not currently draining or already drained.
Procedure

1. To start a drain operation on an external disk:
   1. Select the storage system.
   2. Select Storage > Storage Groups Dashboard.
   3. In the Storage Resource Pools section, select the SRP.
   4. In the Reports section, click View SRP Details.
   5. In the Disk Groups section, click the disk group name. The external disks list appears.
   6. Click Start Draining. The Drain eDisk dialog displays and prompts for confirmation that you want to start a draining operation.
   7. Do one of the following:
      - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
      - Expand Add to Job List, and click Run Now to perform the operation now.

Stop draining external disks

Before you begin
You can stop the drain operation on an external disk only if it is currently draining.

Procedure

1. To stop a draining operation on an external disk:
   1. Select the storage system.
   2. Select Storage > Storage Groups Dashboard.
   3. In the Storage Resource Pools section, select the SRP.
   4. In the Reports section, click View SRP Details.
   5. In the Disk Groups section, click the disk group name. The external disks list appears.
   6. Click Stop Draining. The Drain eDisk dialog appears and prompts for confirmation that you want to stop a draining operation.
   7. Do one of the following:
      - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
      - Expand Add to Job List, and click Run Now to perform the operation now.

Activating external disks

Before you begin
This action can be performed only for HYPERMAX OS 5977 or higher.

You can activate an external disk if it is in a draining, drained, or disabled state.

Procedure

1. To activate an external disk:
   1. Select the storage system.
2. Select Storage > Storage Groups Dashboard.
3. In the Storage Resource Pools section, select the SRP.
4. In the Reports section, click View SRP Details.
5. In the Disk Groups section, click the disk group name.
   The external disks list displays.
6. Select one or more external disks. Click Activate.
7. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Understanding Federated Tiered Storage

Federated Tiered Storage (FTS) allows you to attach external storage to a VMAX system. Attaching external storage allows you to use physical disk space on existing VMAX systems while gaining access to VMAX features such as local replication, remote replication, storage tiering, data management, and data migration.

FTS requires Enginuity 5876 and is not supported on VMAX systems running HYPERMAX OS 5977 or higher.

For additional information on FTS, refer to the following documents:

- Symmetrix Federated Tiered Storage (FTS) Technical Notes
- Solutions Enabler Array Management CLI Product Guide
- Solutions Enabler TimeFinder Family CLI User Guide
- Symmetrix VMAX Family with Enginuity (10K, 20K, 40K) Product Guide

Virtualizing external LUNs

**Procedure**

1. To virtualize external LUNs:
   1. Select the storage system.
   2. Select Storage > External Storage.
   3. (Optional) Click the Not Virtualized check box above the filtered list view to see a list of external LUNs that have not been virtualized.
   4. Select the external LUNs that you want to virtualize.
   5. Click Virtualize to open the Virtualize External LUNs dialog.
   6. Select an import method from the Import Method drop-down menu. This determines the mode of operation for the eDisk.

   **WARNING**

   Selecting Raw Space - External Provisioning, deletes any data that is currently on the external volume.

   7. Select an external disk group from the Disk Group drop-down menu, or type a disk group name to create a new external disk group. Enginuity adds the virtualized external LUNs to the specified external disk group.
8. If you are using Virtual Provisioning, select an empty pool or an existing pool composed of externally provisioned data volumes from the Thin Pool drop-down menu. Type a pool name if you want to create a new pool.

9. Do one of the following:

- **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

- **Click Show Advanced** to continue setting the advanced options, as described next.

**Setting Advanced options:**

a. To override the auto meta member capacity configured on the storage system, specify the unit of measurement by selecting GB, MB, or CYL from the drop-down menu, and then select a capacity from the **Meta Member Capacity** drop-down menu. The Total Enabled Pool Capacity in GB is displayed.

b. If you want all of the created storage volumes to be the same capacity, click the **Create Equal Meta Member Capacity** check box. If you do not select this check box, the meta tail is smaller than the other volumes in the meta.

c. If you want to specify a DX director for the path to the eDisk, select a director from the **DX Director** drop-down menu.

d. **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

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**Understanding storage templates**

Storage templates are a reusable set of storage requirements that simplify storage management for virtual data centers by eliminating many of the repetitive tasks required to create and make storage available to hosts/applications. With this feature, Administrators and Storage Administrators create templates for their common provisioning tasks and then invoke them later when performing such things as:

- Creating or expanding storage groups (Auto-provisioning Groups).
- Creating volumes (regular and thin).

In addition, storage templates can be shared (using import and export) between administrators and among Unisphere servers to help facilitate consistency across the storage environment.

Storage templates require Enginuity 5876 and storage groups.

---

**Creating storage templates**

**Before you begin**

- Storage templates require Enginuity 5876.
- This feature is only available for a user with Admin or StorageAdmin permission.

To create a storage template:

**Procedure**

1. Select **Storage > Storage Templates** to open the **Storage Template** list view.
2. Click Create to open the Create Storage Template wizard.

3. Type a Storage Template Name.
   Storage template names can be up to 64 character long.

4. Select the Symmetrix ID with which the template will be associated or select Any to associate the template with any supported storage system.

5. Select whether to include Virtual or Regular volumes in the template.

6. Specify the capacity that the template will find or create capacity by typing the Number of Volumes, and selecting a Volume Capacity.

7. Click Next.

8. Do the following, depending on whether you are including virtual or regular volumes in the template:
   Virtual volumes:
   a. Select a Volume Configuration.
   b. Select the Thin Pool to which you are going to bind the volumes.
   Regular volumes:
   a. Select the RAID Protection level.
   b. Select Create BCV Volume, if required.
   c. If the template will be associated with a specific storage system, select the target Disk Technology and Disk Group (name and number).

9. Click one of the following:
   • Next to verify your selection and create the template.
   • Show Advanced to continue setting the advanced options as described next.

Setting Advanced options:
   a. If you are including virtual volumes in the template, complete the following steps:
      • To preallocate the entire volume, select Allocate Full Volume Capacity.
      • To maintain the amount of preallocated space through thin volume reclaims and volume copies, select Persist preallocated capacity through reclaim or copy.
   b. To specify the Method to use when selecting volumes, select one of the following:
      • Best Effort—Specifies to satisfy as much as possible of the total requested capacity from existing volumes, and then create the volumes necessary to meet any shortfall.
      • Existing Volumes—Specifies to select from existing volumes.
      • Create New Volumes—Specifies to create new volumes.
   c. To use SRDF volumes in the template, select one of the following; otherwise, leave this field set to None.
      • None — Specifies to not use SRDF volumes.
      • RDF Dynamic — Specifies to only use dynamic SRDF volumes.
• **R1** — Specifies to only use R1 volumes. This option is only available when you are creating or modifying a template that uses the Find Existing method for locating volumes; except when the volumes are thin (TDEVs), in which case this option is not available.

d. Select the volume **Emulation**. The storage template uses only volumes of the specified emulation.

e. To include metavolumes in the template, select **Create Meta** and complete the following steps:
   - Select the **Meta Volume Configuration**. The storage template uses only meta volumes of the specified configuration.
   - Select the **Meta Volume Member Capacity**. The storage template uses only meta volumes of the specified capacity.

f. Click **Next**.

g. Verify your selections in the **Summary** page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.

h. Click **Finish**.

### Exporting storage templates

**Before you begin**

- Storage templates require Enginuity 5876.
- The user must have Administrator or StorageAdmin permission.

**Procedure**

1. To export storage templates to a temporary directory on the Unisphere server:
   1. Select **Storage > Storage Templates** to open the **Storage Template** list view.
   2. Select one or more templates and click **Export**.
   3. Click **OK** in the confirmation message.
   4. Copy the templates from one Unisphere server to the other.

   Templates reside in the server's template directory (`Install_directory \EMC\SMAS\jboss\domain\servers\server-0\data\Template Files`).

### Importing storage templates

**Before you begin**

- Storage templates require Enginuity 5876.
- The user must have Administrator or StorageAdmin permission.
- One or more exported storage templates.

**Procedure**

1. To import storage templates to a Unisphere server:
   1. Select **Storage > Storage Templates** to open the **Storage Template** list view.
   2. Click **Import** to open the **Import Storage Template** list.

   All previously exported storage templates display.
3. Select one or more templates and click OK.

Deleting storage templates

**Before you begin**
- Storage templates require Enginuity 5876.
- This feature is only available for a user with Administrator or StorageAdmin permission.

To delete a storage template:

**Procedure**
1. Select Storage > Storage Templates to open the Storage Template list view.
2. Select the template and click Delete.
3. Click Delete in the confirmation box.

Viewing storage templates

**Procedure**
1. Select the storage system.
2. Select Storage > Storage Templates to open the Storage Template list view.
   
The Storage Template list view allows you to view and manage storage templates.
   
   The following properties display:
   - **Storage Template Name**—Name of the template.
   - **Symmetrix ID**—Storage system associated with the template. Any indicates that the template is associated with any Symmetrix system running Enginuity 5876 or higher connected to the server.
   - **Volume Type**—Type of volume specified in the template.
   - **Protection/Volume Configuration**—RAID protection level/Thin or Thin BCV.
   - **Total Request Capacity (GB)**—Capacity the template will find or create.
   - **Emulation**—Emulation type of the disks specified in the template.
   - **Method**—Method the template is using to select volumes. Possible values are:
     - **Best Effort**—Specifies to satisfy as much as possible of the total requested capacity from existing volumes, and then create the volumes necessary to meet any shortfall.
     - **Existing Volumes**—Specifies to select from existing volumes.
     - **Create New Volumes**—Specifies to create new volumes.

   The following controls are available:
   - **Create**—Creating storage templates on page 336
   - **View Details**—Viewing storage template details on page 340
   - **Import**—Importing storage templates on page 338
   - **Export**—Exporting storage templates on page 338
Viewing storage template details

Procedure

1. Select the storage system.
2. Select Storage > Storage Templates to open the Storage Template list view.
3. Select the storage template and click View Details to open its Details view.

The storage template Details view allows you to view and manage storage templates.

Depending on configuration, some of the following properties display:

- **Template Name**—Name of the template. To rename a template, type a new name over the existing and click Apply. Storage template names can contain up to 64 characters.
- **Symmetrix ID**—The identifier of the associated storage system. Any indicates that the template is associated with all supported storage systems.
- **Volume Type**—The template specifies virtual or regular volumes.
- **Number of Volumes**—The number of volumes the template will find/create.
- **Volume Capacity**—Capacity of each volume.
- **Total Requested Capacity**—Total requested capacity.
- **Create Meta**—Whether the template will find/create meta volumes.
- **Meta Volume Configuration**—Configuration of the meta volumes (Striped or Concatenated).
- **Meta Volume Member Capacity**—Capacity of each meta member.
- **Meta Volume Member Count Including Head**—Number of meta members, including the head.
- **Protection/Volume Configuration**—Protection level/configuration of the volumes used in the template.
- **Disk Group**—Disk group from which the template is finding/creating volumes.
- **Disk Technology**—Disk technology type.
- **Thin Pool**—Thin pool to which the thin volumes are bound.
- **Preallocated Capacity for each volume**—How much of each volume is preallocated.
- **Persist Preallocation Through Reclaim or Copy**—Whether to maintain the amount of preallocated space through thin volume reclaims and volume copies.
- **Method**—Method used to select volumes. Possible values are:
  - **Best Effort**—Specifies to satisfy as much as possible of the total requested capacity from existing volumes, and then create the volumes necessary to meet any shortfall.
  - **Existing Volumes**—Specifies to select from existing volumes.
  - **Create New Volumes**—Specifies to create new volumes.
• **Dynamic RDF Capability**—RDF capability of the volumes in the template. Possible values are:
  - **None**—Specifies to not use SRDF volumes.
  - **RDF Dynamic**—Specifies to only use dynamic SRDF volumes.
  - **R1**—Specifies to only use R1 volumes. This option is only available when you are creating/modifying a template that uses the Find Existing method for locating volumes; except when the volumes are thin (TDEVs), in which case this option is not available.

• **Emulation**—Emulation of the volumes in the template.

The following controls are available:

- **Create**—Creating storage templates on page 336
- **Delete**—Deleting storage templates on page 339
- **Apply**—Applies changes made in the **Properties** list. For example, renaming the storage group.
- **Cancel**—Cancels changes made in the **Properties** list.

## Modifying storage templates

### Before you begin

- Storage templates require Enginuity 5876.
- The user must have Administrator or StorageAdmin permission.

### Procedure

1. To modify a storage template:
   1. Select **Storage** > **Storage Templates** to open the **Storage Template** list view.
   2. Select the template and click **Edit** to open the **Edit Storage Template** wizard.
   3. Modify the template as you step through the wizard.
   4. Click **Finish**.

## Select Template dialog box

Use this dialog box to select a template for use when performing the following operations:

- Creating volumes using storage templates on page 215
- Creating storage groups (Enginuity 5876) on page 111

## Reserving volumes

### Procedure

1. Select the storage system.
2. Select **System** > **System Dashboard**.
   
   Opens the system **Dashboard**.
3. In the **Summary** panel, click **View Reservations**.
   
   Opens the **Reservations** list view.
4. Click Create.
   The Create Reservation wizard opens.
5. Locate the volumes by selecting or typing values for any number of the following criteria:
   - **Capacity equal to**—Filters the list for volumes with a specific capacity.
   - **Volume ID**—Filters the list for a volume with specific ID.
   - **Volume Identifier Name**—Filters the list for the specified volume name.
   - **Additional Criteria**—Allows you to add conditional expressions to your query, as described next:
6. Select values for the following:
   - **Category**—Specifies the broad category.
   - **Attribute**—Refines the category.
   - **Operator**—Establishes the relationship between the attribute and the value.
   - **Value**—Conditions for the specified attribute.
7. To add another expression, click Add Another, and repeat the previous step. To clear your criteria, click Clear All.
8. Click Find Volumes, and select the volumes.
9. Type any Comments regarding the reservation. The requirement for this field is set in system preferences.
10. Select Expiration and click calendar.
    The Reservation Expiration dialog box opens.
11. Select an Expiration Date and Expiration Time.
12. Click OK, then click Reserve to create the reservation.

### Adding volumes to reservations

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
   Opens the system **Dashboard**.
3. In the **Summary** panel, click **View Reservations**.
   Opens the **Reservations** list view.
4. Select the reservation and click **View Details**.
   Opens the **Details** view.
5. Click **Add**.
   Opens the **Add Volumes to Reservations** wizard.
6. Locate the volumes by selecting/typing values for any number of the following criteria:
   - **Capacity equal to**—Filters the list for volumes with a specific capacity.
   - **Volume ID**—Filters the list for a volume with specific ID.
   - **Volume Identifier Name**—Filters the list for the specified volume name.
7. Click **Find Volumes** to run the query now, or **Show Advanced** to add conditional expressions to your query, as described next.

8. Select values for the following, then click **Add**.
   - **Category**—Specifies the broad category.
   - **Attribute**—Refines the category.
   - **Operator**—Establishes the relationship between the attribute and the value.
   - **Value**—Conditions for the specified attribute.

9. Repeat the previous step for each additional expression.

10. Click **Find Volumes**.

11. Select **Volumes** and click **Add to Reservations**.

### Removing volumes from reservations

**Procedure**

1. Select the storage system.

2. Select **System > System Dashboard**.

   Opens the system Dashboard.

3. In the **Summary** panel, click **View Reservations**.

   Opens the Reservations list view.

4. In the **Related Objects** section of the **Properties** dialog, click **Reserved Volumes**.

5. In the **Reserved Volumes** list, select reservation and click **Remove**.

6. Click the **OK**.

### Releasing reservations

**Procedure**

1. Select the storage system.

2. Select **System > System Dashboard**.

   Opens the system Dashboard.

3. In the **Summary** panel, click **View Reservations**.

   Opens the Reservations list view.

4. Select one or more reservations and click **Release**.

5. Click **OK**.

### Viewing reservations

**Procedure**

1. Select the storage system.

2. Select **System > System Dashboard**.

   Opens the system Dashboard.

3. In the **Summary** panel, click **View Reservations**.

   Use the **Reservations** list view to display and manage reservations for the storage system.
The following properties display:

- **Reservation**—Reservation ID.
- **Owner**—User that created the reservation.
- **Application**—Application used to create the reservation.
- **Host**—Host from which the reservation was created.
- **Reserved Volumes**—Number of reserved volumes.
- **Creation**—Date/time the reservation was created.
- **Expiration**—Date/time the reservation will expire. The default value is Never.
- **User Comment**—User-supplied comments.

The following controls are available:

- **Create**—Reserving volumes on page 341
- **View Details**—Viewing reservation details on page 344
- **Release**—Releasing reservations on page 343

### Viewing reservation details

**Procedure**

1. Select the storage system.
2. Select System > System Dashboard.
   
   Opens the system Dashboard.
3. In the Summary panel, click View Reservations.
   
   Opens the Reservations list view.
4. Select the reservation and click View Details.

Use the details view to display and manage a reservation. This view contains two panels, **Properties** and **Related Objects**. The **Properties** panel displays the following:

- **Reservation**—Reservation ID.
- **Owner**—User that created the reservation.
- **Application**—Application used to create the reservation.
- **Host**—Host from which the reservation was created.
- **Reserved Volumes**—Number of reserved volumes.
- **Creation**—Date/time the reservation was created.
- **Expiration**—Date/time the reservation will expire. Never is the default.
- **User Comment**—User-supplied comments.

The following controls are available:

- **Create**—Reserving volumes on page 341
- **Release**—Releasing reservations on page 343
- **Add**—Adding volumes to reservations on page 342

The **Related Objects** panel provides links to views for objects contained in and associated with the reservation. Each link is followed by a number, indicating
the number of objects in the corresponding view. For example, clicking Reserved Volumes - 2 will open a view listing the two volumes held in the reservation.

Viewing reserved volumes

**Procedure**

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click View Reservations.
4. Select the reservation and click View Details.
5. In the Related Objects panel, click Reserved Volumes.

The Reserved Volume list view is displayed. Use the Reserved Volumes list view to display and manage the volumes held in a reservation.

The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Status**—Volume status.
- **Reserved**—Indicates whether the volume is reserved.
- **Emulation**—Emulation type for the volume.

The following controls are available:

- **View details**—Viewing reserved volume details on page 345.
- **Add**—Adding volumes to reservations on page 342.
- **Remove**—Removing volumes from reservations on page 343.

**Viewing reserved volume details**

**Procedure**

1. Select the storage system.
2. Select System > System Dashboard.

Opens the system dashboard.

3. In the Summary panel, click View Reservations.

Opens the Reservations list view.

4. Select the reservation and click View Details.

Opens the Details view.

5. In the Related Objects panel, click Reserved Volumes to open the Reserved Volumes list view.

The following properties display:

- **Name**—Volume name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **Symmetrix ID** — Storage system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the consistency group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume 's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume 's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume 's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
• **Host Access Mode**—Host access mode.
• **Pinned**—Whether the volume is pinned.
• **RecoverPoint tagged**—Indicates whether volume is tagged for RecoverPoint.
• **Service State**—Service state.
• **Defined Label Type**—Type of user-defined label.
• **Dynamic RDF Capability**—RDF capability of the volume.
• **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
• **Mirror Set DA Status**—Volume status information for each member in the mirror set.
• **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
• **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
• **Dynamic Cache Partition Name**—Name of the cache partition.

**Reservation Expiration dialog box**

Use this dialog box to specify an expiration date/time for a reservation.

**Viewing reserved volume mapping information**

**Procedure**

1. Select the storage system.
2. Select System > System Dashboard.
   
   Opens the system Dashboard.
3. In the Summary panel, click View Reservations.
   
   Opens the Reservations list view.
4. Select the reservation and click View Details.
   
   Opens the Details view.
5. In the Related Objects panel, click Reserved Volume Mapping.
   
   Opens the Reserved Volume Mapping list view.

The following properties display:

• **Port**—Port to which the volume is mapped.
• **Mapped Address**—LUN address.

**Understanding Optimizer**

Optimizer improves storage system performance by continuously monitoring the back-end activity and swapping highly active volumes with idle volumes to achieve a balanced workload across the disks. This automated, continuous process is based on user-defined parameters and is completely transparent to end users, hosts, and applications in the environment.
Managing Optimizer

The Optimizer dashboard provides you with a single place from which to manage Optimizer.

Before you begin:

- Optimizer is supported on storage systems running an Enginuity version lower than 5977.

To access the Optimizer dashboard:

1. Select the storage system.
2. Select Storage > Optimizer.

The Optimizer dashboard provides access to the following Optimizer parameters:

- **Shared Parameters:**
  - The following parameters are shared between Optimizer and FAST. Therefore, changes made to these parameters will affect both Optimizer and FAST:
    - **Data Movement Mode**—Specifies whether to move data automatically (Automatic) or to wait for user approval before moving data (User Approved).
    - **Maximum Number of Volumes Moved Per Day**—Specifies the maximum number of moves to perform in a 24 hour period, starting at 12:00 AM. Possible values range from 2 to 200.
    - **Maximum Simultaneous Volumes Moved**—Specifies the maximum number of moves that can be performed at one time. Possible values range from 2 to 32.

- The following parameters are shared between Optimizer and FAST VP:
  - **Workload Analysis Period**—Specifies the amount of workload sampling to maintain for sample analysis. Possible values are specified in units of time (hours, days, or weeks) and can range from 2 hours to 4 weeks, with the default being one week.
  - **Time to Sample before First Analysis**—Specifies the minimum amount of workload sampling to complete before analyzing the samples for the first time. When setting this parameter, be sure to allow enough time (usually a week) to establish a good characterization of the typical workload. This parameter allows you to begin operations before the entire Workload period has elapsed. Possible values range from 2 hours to the value specified for the Workload Analysis Period parameter, with the default being eight hours.

- **Optimizer Specific Settings:**
  - **Startup Mode**—Specifies whether Optimizer starts automatically with the service processor (Automatic), or if it requires manual intervention (Manual). This option does not apply/display for VMAX arrays running Enginuity 5876 or later.
  - **Hot Spot Analysis**—Specifies whether to run the hot spot analysis algorithm. The hot spot analysis algorithm attempts to improve VMAX performance by swapping devices that it determines will reduce disk access times.
Maintain Physical Mirror—Specifies whether Optimizer should maintain any RAID 5 groups. This option does not apply/display for VMAX arrays running Enginuity 5876 or later.

Maintain RAID 5 Groups—Specifies whether Optimizer should maintain any RAID 5 groups. This option does not apply/display for VMAX arrays running Enginuity 5876 or later.

DMX Lock Status: Host that currently holds the Optimizer lock on the VMAX service processor. This option does not apply/display for VMAX arrays running Enginuity 5876 or later.

Optimizer Status: Optimizer's current state. The Optimizer dashboard provides access to the following Optimizer controls:

- Swap/Move List—Viewing Optimizer swap/move lists on page 351.
- Swap/Move History—Viewing Optimizer swap/move history on page 352.
- Approve Swap—Approving Optimizer Swaps on page 350.
- Start/Lock—Lock/Unlock/Start/Stop dialog box on page 352 (Does not apply/display for Enginuity 5876 or later).
- Enable/Disable—Enabling/Disabling Optimizer on page 349 (Does not apply/display for versions lower than Enginuity 5876).
- Apply—Applies changes made in the parameter list.
- Cancel—Cancels changes made in the parameter list.

Starting/Stopping Optimizer

The following explains how to start/stop Optimizer on a Unisphere client. Before you begin:

- Optimizer is supported on storage systems running an Enginuity version lower than 5977.
- This procedure is only required when performing operations on a storage system running an Enginuity version lower than 5876.

To start/stop Optimizer:

Procedure

1. Select the storage system.
2. Select Storage > Optimizer to open the Optimizer dashboard.
3. Click Start/Lock to open the Lock/Unlock/Start/Stop dialog box.
4. Click Start or Stop.
5. Click OK.
6. Click OK in the confirmation message.

Enabling/Disabling Optimizer

Before you begin

- Optimizer is supported on storage systems running an Enginuity version lower than 5977.
- This procedure explains how to enable/disable Optimizer on a VMAX system running Enginuity 5876 or later:

To enable/disable Optimizer:
Procedure

1. Select the storage system.
2. Select Storage > Optimizer to open the Optimizer dashboard.
3. Click Enable/Disable to open the Enable/Disable dialog box.
4. Click Enable or Disable.
5. Click OK.
6. Click Close.

Locking/Unlocking Optimizer

The following explains how to lock/unlock Optimizer controls. Locking Optimizer prevents other uses from making changes while you are working with the software.

Before you begin:
- Optimizer is supported on storage systems running an Enginuity version lower than 5977.
- This procedure is only required when performing operations on a storage system running an Enginuity version lower than 5876.

To lock/unlock Optimizer:

Procedure

1. Select the storage system.
2. Select Storage > Optimizer to open the Optimizer dashboard.
3. Click Start/Lock to open the Lock/Unlock/Start/Stop dialog box.
4. Click Lock or Unlock.
5. Click OK.
6. Click OK in the confirmation message.

Approving Optimizer Swaps

Before you begin

Optimizer is supported on storage systems running an Enginuity version lower than 5977.

Procedure

1. Select the storage system.
2. Select Storage > Optimizer to open the Optimizer dashboard.
3. Click Approve Swap to open the Approve Swap dialog box.

The following properties display, depending on the Enginuity version running on the storage system:
- Group—Group number associated with the swaps/moves.
- Volume 1—First volume involved in the swap/move.
- Volume 2—Second volume involved in the swap/move.
- Status—Status of the swap/move.
- Execution Time—Time the swap/move started.
- Type—Whether the plan was manually defined or auto generated by FAST or by Optimizer.
Enginuity versions lower than 5876:

- **Group**—Group associated with the swaps/moves.
- **Volume 1**—Volume being moved/swapped.
- **Mirror/Member**—Mirror position of the volume.
- **From**—Original location of the volume.
- **To**—New location of volume.
- **Status**—Status of the swap/move.
- **Execution Time**—Time the swap/move started.
- **Type**—Whether the plan was Manually Defined or Auto Generated by FAST or by Optimizer.

4. Select a swap.
5. Select the Schedule for execution. Do one of the following:
   - Select **According to Optimizer policy**.
   - Specify a date and time.
   - Select **Decline Plan**.

### Viewing Optimizer swap/move lists

The following explains how to view information on the current Optimizer/FAST plan:

**Procedure**

1. Select the storage system.
2. Select **Storage > Optimizer** to open the **Optimizer** dashboard.
3. Click **Swap/Move List** to open the **Swap/Move List** dialog box.

   The following properties display, depending on the Enginuity version running on the storage system:
   
   **Enginity 5876 or later:**
   - **Group**—Group associated with the swaps/moves.
   - **Volume 1**—First volume involved in the swap/move.
   - **Volume 2**—Second volume involved in the swap/move.
   - **Status**—Status of the swap/move.
   - **Execution Time**—Time the swap/move started.
   - **Type**—Whether the plan was Manually Defined or Auto Generated by FAST or by Optimizer.
   - **Group Percent Complete**—How much (%) of the plan is complete.
   - **Estimated Time to Completion**—How long until the plan is complete.

**Enginuity versions lower than 5876:**

- **Group**—Group associated with the swaps/moves.
- **Volume**—Volume being moved/swapped.
- **Mirror/Member**—Mirror position of the volume.
- **From**—Original location of the volume.
- **To**—New location of volume.
- **Status** — Status of the swap/move.
- **Execution Time** — Time the swap/move started.
- **Type** — Whether the plan was Manually Defined or Auto Generated by FAST or by Optimizer.

4. To refresh the list of swaps/moves, click **Refresh**.

**Viewing Optimizer swap/move history**

The following explains how to view information on the past Optimizer/FAST swaps/moves:

**Procedure**

1. Select the storage system.
2. Select **Storage > Optimizer** to open the Optimizer dashboard.
3. Click **Swap/Move History** to open the **Swap/Move History** dialog box.
4. Specify the time range you are interested in and click **Run Filter**.

The following properties display, depending on the Enginuity version running on the storage system:

Enginity 5876 or later:
- **Group** — Group associated with the swaps/moves.
- **Volume 1** — First volume involved in the swap/move.
- **Volume 2** — Second volume involved in the swap/move.
- **Start Time** — Time (in Eastern Daylight Time) the swap/move started. EDT is 4 hours behind of Coordinated Universal Time (UTC).
- **End Time** — Time (in Eastern Daylight Time) the swap/move completed. EDT is 4 hours behind of Coordinated Universal Time (UTC).
- **Type** — Whether the plan was Manually Defined or Auto Generated by FAST or by Optimizer.

Enginuity versions lower than 5876:
- **Group** — Group associated with the swaps/moves.
- **Volume** — Volume being moved/swapped.
- **Mirror/Member** — Mirror position of the volume.
- **Hyper From** — Original location of the volume.
- **Hyper To** — New location of volume.
- **Attributes** — Whether the plan was Manually Defined or Auto Generated by FAST or by Optimizer.
- **Start Time** — Time (in Eastern Daylight Time) the swap/move started. EDT is 4 hours behind of Coordinated Universal Time (UTC).
- **End Time** — Time (in Eastern Daylight Time) the swap/move completed. EDT is 4 hours behind of Coordinated Universal Time (UTC).

**Lock/Unlock/Start/Stop dialog box**

Use this dialog box to control basic Optimizer operations, including
Managing vVols

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.
The VVols Dashboard provides you with a single place to monitor and manage vVols.
To access the VVols Dashboard:

Procedure
1. Select the storage system.
2. Select Storage > VVols Dashboard.

VVols Dashboard:
The VVols Dashboard is organized into the following panels:

Summary
Displays the following vVol summary information:

- **Storage Containers** — The number of storage containers on the selected storage system.
  Click **Storage Containers** to display the Storage Containers list view. For more information about viewing storage containers, refer to Viewing storage containers on page 354.

- **Protocol Endpoints** — The number of protocol endpoints on the selected storage system.
  Click **Protocol Endpoints** to display the Protocol Endpoints list view. For more information about protocol endpoints, refer to Viewing protocol endpoints on page 359.

- **PE Masking Views** — The number of masking views that contain protocol endpoints.
  Click **PE Masking Views** to display the PE Masking Views list view. For more information about PE masking views, refer to Viewing masking views on page 396.

To view additional information on a particular object, click its icon to open the corresponding list view.

Common Tasks
Displays links to the following common tasks:

- **Create Storage Container** — Creating storage containers on page 355
- **Provision Protocol Endpoint to Host** — Provisioning protocol endpoints to hosts on page 360
- **Storage Container Alerts** — Viewing storage container alerts on page 361

VASA Provider Status
Displays one of the following icons representing the status of the VASA provider:

- ✔ — The VASA provider is online.
- ✗ — The VASA provider is offline.
• 🔄 — A connection to the VASA provider has not been configured.

• ⚠️ — There was an error connecting to the VASA provider.

To refresh the status of the VASA provider, click 🔄.
To create a connection to the VASA provider, click Create Connection. To edit an existing connection, click Edit Connection. For more information about configuring a connection to the VASA provider, see Configuring the VASA provider connection on page 362.

Symmetrix Consumed Capacity - Subscribed
Displays a bar graph representing how much subscribed space all storage containers consume on the storage system.

Storage Resources Consumed Capacity - Subscribed
Displays a list of storage resources within all containers on the storage system, showing the current usage of each storage resource, ascending by usage.

• Name — The name of the capability profile.
• Subscribed Used(%) — The current percent of subscribed tracks within the storage resource in relation to the limit imposed on the capability profile.
• Limit (GB) — The subscribed limit imposed on the storage resource.
• Container — The name of the storage container with which the storage resource is associated.
• Compression — If compression is enabled on this storage resource a tick will appear. If it's disabled a horizontal dash will appear.

Viewing storage containers

To view the storage container list:

Procedure
1. Select the storage system.
2. Select Storage > VVols Dashboard.
3. Click Storage Containers to display the Storage Containers list view.

The following properties display:

• Name — The name of the storage container.
• Storage Resources — The number of associated storage resources.
• Subscribed Used (%) — The current percentage of subscribed tracks within the storage container, in relation to the limit imposed on all of the storage resources within the storage container.
• Subscribed Limit (GB) — The current total limit of all storage resources in GB.

The following controls are available:

• Create Container — Creating storage containers on page 355
• Delete — Deleting storage containers on page 356
• View Details — Viewing storage container details on page 355
Viewing storage container details

To view storage container details:

Procedure
1. Select the storage system.
2. Select Storage > VVols Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container. Click View Details.

The following properties display:

- **Name** — The name of the storage container.
- **Description** — The description of the storage container. This field is editable.
- **Subscribed Capacity Limit (GB)** — The total combined limit of all storage resources within the storage container.
- **Subscribed Capacity Used (GB)** — The current subscribed usage on the storage container of all of the storage resources within the storage container.
- **Subscribed Capacity Free (GB)** — The total free subscribed capacity, based on the capacity used and the limit of all of the storage resources in the storage container.
- **Number of Storage Resources** — The total number of storage resources within the storage container.

The following controls are available:

- **Delete** — Deleting storage containers on page 356
- **Apply** — Applies any changes made to the storage container details.
- **Cancel** — Discards any changes made to the storage container details.

Creating storage containers

To create a storage container:

Procedure
1. Select the storage system.
2. Select Storage > VVols Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Click Create Container. The Create Storage Container wizard displays.
5. On the Storage Container page, complete the following steps:
   a. Type a name for the storage container.
   b. Optional: Type a description of a storage container.
6. Click Next.
7. On the Storage Resources page, specify at least one storage resource. Default values for a new storage resource are populated.
To remove a storage resource from the list of associated storage resources, hover the mouse over the storage resource and click [X].

To add a storage resource, click **Add Resource** and complete the following steps:

a. In the **Name** field, type a name for the storage resource, or accept the default name.

b. From the **SRP Name** menu, select the SRP to apply to the storage resource.

c. From the **Service Level Name** menu, select the service level to apply to the storage resource. For all-flash storage systems, the only service level available is Diamond and it is selected by default.

d. From the **Workload** menu, select the workload to apply to the storage resource. To view a popup showing the current workload demand report click [i].

e. In the **Subscribed Limit (GB)** field, type the imposed subscribed limit on the storage resource. 0.1 GB is the minimum value allowed.

8. Compression is enabled by default on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher. To disable the feature on this storage container, uncheck the **Compression** check box. For more information, refer to Understanding compression.

9. Click **Next**.

10. On the **Review** page, review the details and do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

## Deleting storage containers

### Before you begin
- The storage system must be running HYPERMAX OS 5977 or higher.
- You cannot delete containers with used capacity.

To delete a storage container:

### Procedure
1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers** to display the **Storage Containers** list view.
4. Select the storage container you want to delete and click **Delete**.
5. Click **OK** in the confirmation message.

## Viewing storage resources

To view the storage resource list:
**Procedure**

1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers** to display the **Storage Containers** list view.
4. Select the storage container. Click **View Details**.
5. In the **Related Objects** pane, click **Storage Resources** to display the **Storage Resources** list view.

The following properties display:

- **Name** — The name of the capability profile.
- **SRP** — The number of the SRP.
- **Service Level** — The name of the service level.
- **Workload** — The name of the workload.
- **Compression** — If compression is enabled on this storage resource a tick will appear. If it's disabled a horizontal dash will appear.
- **Compression Ratio** — The current compression ratio on this storage resource.
- **Subscribed Used (%)** — The current percent of subscribed tracks within the storage resource in relation to the limit imposed on the storage resource.
- **Subscribed Limit (GB)** — The subscribed capacity limit within the storage resource.

The following controls are available:

- **Add** — Adding storage resources to storage containers on page 358
- **Remove** — Removing storage resources from storage containers on page 359
- **View Details** — Viewing storage resource details on page 357

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**Viewing storage resource details**

To view storage resource details:

**Procedure**

1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers**.
4. Select the storage container. Click **View Details**.
5. In the **Related Objects** pane, click **Storage Resources** to display the **Storage Resources** list view.
6. Select the storage resource. Click **View Details**.

The following properties display:

- **Name** — The name of the storage resource.
- **Storage Container** — The name of the associated storage container.
- **SRP** — The name of the associated SRP.
- **Service Level** — The name of the associated service level.
- **Workload** — The name of the associated workload.
- **Subscribed Capacity Limit (GB)** — The subscribed capacity limit imposed. This field is editable.
- **Subscribed Capacity Used (GB)** — The current subscribed usage on the storage resource.
- **Subscribed Capacity Free (GB)** — The subscribed free space on the storage resource.

The following controls are available:

- **Apply** — Applies any changes made to the storage container details.
- **Cancel** — Discards any changes made to the storage container details.

### Viewing storage resource related SRPs

To view the related SRPs of a storage resource:

**Procedure**

1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers** to display the Storage Containers list view.
4. Select the storage container. Click **View Details**.
5. In the **Related Objects** pane, click **Storage Resources** to display the Storage Resources list view.
6. Select the storage resource. Click **View Details**.
7. In the **Related Objects** pane, click the SRP link to display the Storage Resource Pools details view.

For more information about the Storage Resource Pools list view, refer to **Viewing Storage Resource Pools** on page 163.

### Adding storage resources to storage containers

To add a storage resource to a storage container:

**Procedure**

1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers** to display the Storage Containers list view.
4. Select the storage container. Click **View Details**.
5. In the **Related Objects** pane, click **Storage Resources**.
6. Click **Add**.

The **Add Storage Resource To Storage Container** dialog box displays. The details of any existing storage resource are populated automatically.

7. Type **Subscribed Limit (GB)** details for the new storage resource.
8. (Optional) If required, edit the details of the new storage resource, or click the **X** icon to remove it completely.
9. To add an additional resource, click **Add Resource** and specify the following details:
   - **Name** — The name of the storage resource.
   - **SRP Name** — The name of the SRP.
   - **Service Level Name** — The name of the service level.
   - **Workload** — The name of the workload.
     For more information about current workload, click the i icon.
   - **Subscribed Limit (GB)** — The subscribed capacity limit imposed.
   - **Compression** — The Compression check box will be checked if you enabled compression when creating the storage group. Uncheck to disable compression on this particular storage resource. For more information, refer to Understanding compression.

10. After you have added all of the required storage resources, do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Removing storage resources from storage containers**

To remove a storage resource from a storage container:

**Procedure**
1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Storage Containers** to display the **Storage Containers** list view.
4. Select the storage container. Click **View Details**.
5. In the **Related Objects** pane, click **Storage Resources**.
6. Select the storage resource you want to remove and click **Remove**.
7. In the **Remove Storage Resource** dialog, click **OK**.

**Viewing protocol endpoints**

To view the protocol endpoints list:

**Procedure**
1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Protocol Endpoints** to display the **Protocol Endpoints** list view.

   The following properties display:
   - **Name** — The volume ID of the protocol endpoint.
   - **Masking View** — Indicates, using a ✔ or ✗ symbol, if the protocol endpoint is in a masking view or not.
   - **Storage Groups** — The number of associated storage groups.
Reserved — Indicates if the protocol endpoint is reserved or not.
The following controls are available:
- **Delete** — [Deleting protocol endpoints](#) on page 361
- **Set Volume Identifiers** — [Setting volume identifiers](#) on page 225
- **View Details** — [Viewing protocol endpoint details](#) on page 360

### Viewing protocol endpoint details

To view protocol endpoint details:

**Procedure**
1. Select the storage system.
2. Select *Storage > VVols Dashboard*.
3. Click *Protocol Endpoints*.
4. Select the protocol endpoint. Click *View Details*.

The following properties display:
- **Name** — The name of the protocol endpoint.
- **Volume Identifier** — The volume identifier of the protocol endpoint.
- **Status** — The status of the protocol endpoint.
- **Reserved** — The reserved status of the protocol endpoint. Valid values are *Yes* and *No*.
- **Number of Storage Groups** — The total number of storage groups associated with the protocol endpoint.
- **Number of Masking Views** — The total number of masking views associated with the protocol endpoint.

### Provisioning protocol endpoints to hosts

To provision a protocol endpoint to a host:

**Procedure**
1. Select the storage system.
2. Select *Storage > VVols Dashboard*.
3. In the *Common Tasks* pane, click *Provision Protocol Endpoint to Host* to display the Provision Protocol Endpoint to Host wizard.
4. On the *Select Host/Host Group* pane, specify a host or host group. Do one of the following:
   - Select an existing host or host group from the list.
   - To create a new host, click *Create Host*. The *Create Host* dialog displays. For more information, refer to *[Creating hosts](#)* on page 378.
   - To create a host group, click *Create Host Group*. The *Create Host Group* dialog displays. For more information, refer to *[Creating host groups](#)* on page 388.
5. Click *Next*. 
6. On the **Select Port Group** pane, specify a port group. Do one of the following:
   - To create a new port group, select **New**. For more information about creating port groups, refer to Creating port groups on page 406.
   - To use an existing port group, select **Existing**, and select a port group from the **Port Group** list.
7. Click **Next**.
8. On the **Review** page, review the details and do one of the following:
   - Optional: Modify the auto-generated **Masking View** name.
   - Optional: Modify the auto-generated **Storage Group** name.
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Deleting protocol endpoints

**Before you begin**
The storage system must be running HYPERMAX OS 5977 or higher.

To delete a protocol endpoint:

**Procedure**
1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. Click **Protocol Endpoints** to display the Protocol Endpoints list view.
4. Select the protocol endpoint you want to delete and click **Delete**.
5. Click **OK**.

### Viewing storage container alerts

To view the storage container alert list:

**Procedure**
1. Select the storage system.
2. Select **Storage > VVols Dashboard**.
3. In **Common Tasks** pane, click **Storage Container Alerts**.
4. (Optional) Use the alert filter to view a subset of the listed alerts. For more information on the Alert Filter, refer to Filtering alerts on page 53.
   
   The following properties display:
   - **State** — State of the alert. Possible values are New or Acknowledged.
   - **Severity** — Alert severity. Possible values are:
     - Fatal
     - Critical
     - Warning — The following events map to this severity:
       - The component is in a degraded state of operation.
       - The storage array is no longer present (during certain operations).
- The component is in an unknown state.
- The component is (where possible) in a write-disabled state.

- Information — The component is no longer present (during certain operations).
- Normal — The component is now (back) in a normal state of operation.

- Type — Type of alert. Possible values are Array, Performance, Server, System, and File.

- Object — Component to which the alert is related. This is because server alerts are specific to the server or runtime environment and are not associated with a specific object or storage system.

- Description — Description of the alert.
- Created — Date/time the alert was created.
- Acknowledged — Date/time the alert was acknowledged.

The following controls are available:
- View Details — Viewing alert details on page 54
- Acknowledge — Acknowledging alerts on page 54
- Delete — Deleting alerts on page 55

### Configuring the VASA provider connection

To configure the VASA provider connection:

**Procedure**

1. Select the storage system.
2. Select Storage > VVols Dashboard.
3. In the VASA Provider Status pane, do one of the following:
   - To create a new connection, click Create Connection.
   - To edit an existing connection, click Edit Connection.
4. In the VASA Provider Connection dialog box, specify the IP address of the VASA provider.
5. Click OK.

### Understanding non-disruptive migration (NDM)

Non-disruptive migration (NDM) allows you to migrate storage group (application) data in a non-disruptive manner with no downtime from source arrays running Enginuity 5876 Q3 2016 or higher to target arrays running HYPERMAX OS 5977 Q3 2016 or higher.

NDM applies to open systems/FBA devices only.

NDM supports the ability to compress data on all-flash storage systems while migrating.

From Unisphere for VMAX 8.4 onwards, an NDM session can be created on a storage group containing session target volumes (R2s) where the SRDF mode is synchronous. The target volumes of an NDM session may also have a SRDF/Synchronous session added after the NDM session is in the cutover sync state.

The following NDM tasks can be performed from Unisphere for VMAX.
Managing non-disruptive migration (NDM) environments

This procedure explains how to manage (setup, remove and verify migration connectivity) the non-disruptive data migration environment.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.

Before you begin:

The source storage array to be migrated is running 5876 Q3 2016, or higher.
The remote (target) storage array is running HYPERMAX OS 5977 Q3 2016, or higher.
SRDF connectivity (zoning) exists between the two arrays.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.

To manage migration environments:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.
3. Click and click Manage Environments.
4. Select one of the following:
   - **Validate**—used to validate that there is a migration environment set up between the storage system being worked on and another array.
   - **Setup**—sets up a migration environment with another array.
   
   You may choose from a list of storage systems running HYPERMAX OS 5977 Q3 2016 or higher that do not already have a NDM environment setup between them and the source storage system.
Preparing a non-disruptive migration (NDM) session

Non-disruptive migration of storage groups using SRDF is supported between a source storage system running Enginuity 5876 Q3 2016 or higher and a target storage system running HYPERMAX OS 5977 Q3 2016 or higher.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.

There are two paths through the migration creation wizard. The default flow is for creating a migration session between two arrays (see Creating a non-disruptive migration (NDM) session on page 366). The secondary flow allows the user to prepare for a data migration with recommendations on the ports to be used for an optimal candidate migration result. When the prepare path is run (this is an option that can be run before the create path), you have the option to save your preparation to a Migration report containing zoning information. You need to implement the zoning before running the Create scenario in anticipation of the migration creation. If the plan is changed after running the prepare, these port groups need to be renamed or removed.

If the user chooses the prepare path first, the same Symmetrix and SRP must be selected when running the second path for creating the actual migration session.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.

The data migration environment exists between two candidate arrays (see Managing non-disruptive migration (NDM) environments on page 363).

The selected storage group is a masked candidate storage group.

The selected storage group does not contain only gatekeepers.

The local array must have online RDF ports.

Unisphere for VMAX is registered for performance data processing on the source and target arrays. When you register a storage system for performance data collection it takes at least two intervals (by default, 5 minutes each) before performance data begins to populate in the Unisphere GUI and charts.

To prepare a migration session:

Procedure

1. Select a storage system running Enginuity 5876 Q3 2016 or higher.
2. Select Storage > Storage Groups Dashboard and, in the Storage Groups panel, click Total to open the Storage Groups list view.
3. Select a storage group.
4. Click and click Migrate.
5. On the Destination page, select the target storage system.

The first Symmetrix on the list is selected in the Symmetrix combo.

   Not specifying an SRP is allowed for data migration creation.

7. Click **Next**.

8. On the **Prepare** page, do the following:

   - **Select Prepare Data Migration**
     - If the source or target array is remote to this instance of Unisphere for VMAX, performance data processing is not registered on the target array, or there has not being sufficient time (at least two intervals (by default, 5 minutes each)) to gather performance data, an error popup informs you of this and the **Next** button is disabled.

     If any source port groups do not already exist on the target array, a panel is displayed allowing the user to select ports for any port group(s) to be created.

     All port group(s) involved in this migration are displayed. Any port group(s) that need to be created on the target array are at the top and any that already exist are at the bottom. Any existing port group(s) have the text "Already configured" in the title.

     Any port group to be created displays a selectable list of ports. This list of ports includes all available ports on the target array, but to avoid overlap, port(s) already in use by any existing target array port group(s) are filtered out of the list.

     The port table within the panel contains the following columns:

     - **Port**—The port identifier of a target array port in Dir:Port format with a checkbox for selection.

     - **Utilization**—a bar indicating a utilization score for the port. A lower score indicates lower utilization. This is the default sort column for the list.

     - **Initiators**—a number indicating how many initiators, from the list of all initiators in the corresponding source Masking View associated with the source Storage Group, are present in the Login History Table for the port on the target array.

     Ports are selected by default based on the Utilization value. The number of default selected ports is equal to the number of ports in the source port group or the number of ports still available in the original list. You are able to override these selections, but you must select at least one port.

   - Click **Next**.

   - On the **Summary** page, review the details. The summary includes information any port group(s) and ports that you selected. There is also a suitability score for the entire migration request indicating the expected impact of the migrated application on the target array's front end ports. A message, indicating whether or not the selected front end ports have sufficient performance capacity for the incoming load, is displayed. Do one of the following:

     - Optional: Click **Save Migration report** to save the report to your chosen location.
You need to implement zoning based on the information in the Migration report. You need to implement zoning before running the Create scenario as well as creating the required port groups on the target array in anticipation of the migration creation. If the plan is changed after running the prepare, these port groups need to be renamed or removed.

- Click Finish to perform the port group(s) creation (if any) on the target array depending on your selections.

**Note**

Clicking **Finish** does not create the migration session.

### Creating a non-disruptive migration (NDM) session

Non-disruptive migration of storage groups using SRDF is supported between a source storage system running Enginuity 5876 Q3 2016 or higher and a target storage system running HYPERMAX OS 5977 Q3 2016 or higher.

See [Understanding non-disruptive migration (NDM)](#) on page 362 for additional information.

There are two paths through the migration creation wizard. The default flow is for creating a migration session between two arrays. The secondary flow will allow the user to prepare for a data migration (see [Preparing a non-disruptive migration (NDM) session](#) on page 364).

**Before you begin:**

To perform this procedure you must be an Administrator or Storage Admin.

The data migration environment exists between two candidate arrays (see [Managing non-disruptive migration (NDM) environments](#) on page 363).

The selected storage group is a masked candidate storage group.

The selected storage group does not contain only gatekeepers.

The Initiators in the Storage Groups Masking Views are visible to the target array running HYPERMAX OS 5977 or higher.

The local array must have online RDF ports.

To create a migration session:

**Procedure**

1. Select a storage system running Enginuity 5876 Q3 2016 or higher.

2. Select **Storage > Storage Groups Dashboard** and, in the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.

3. Select a storage group.

4. Click `>` and click **Migrate**.

5. On the **Destination** page, select the target storage system.

   The first Symmetrix on the list is selected in the Symmetrix combo.


   The default SRP is selected on the SRP combo if it can be calculated. Not specifying an SRP is allowed for data migration creation.
7. Click Next.
8. On the Create page, do the following:
   - Select Create Data Migration
   - Optional: Uncheck the Compression check box to turn off Compression. Compression is only allowed on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.
   - Click Next.
   - On the Summary page, review the details. The summary includes information on any Masking View(s) that would be created by this migration and any Port group(s) and Host/Host Group(s) that you selected.
   - Do one of the following:
     - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
     - Expand Add to Job List, and click Run Now to perform the operation now. Review the contents of the feedback dialog. After successful migration, a dialog is displayed. Select Go to Migrations list view, No Further action at this time or Close.

**Results**

If the host can scan the new paths on its own, the migration moves to the CutoverReady state. If a user rescan is needed, the migration state moves to the Created state.

**Viewing the non-disruptive migration (NDM) sessions list**

This procedure explains how to view the list of the non-disruptive migration (NDM) sessions.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.

To view the migration sessions list:

**Procedure**

1. Select the storage system.
2. Select Storage > Migrations to view the Migrations list view.

   The following properties display:
   - **Storage Group**—Name of the storage group.
   - **Capacity (GB)**—Capacity of the storage group in GB.
   - **State**—Migration state. An icon representing the state is also displayed. Failed states are represented as red, in progress states are represented using the refresh icon and states after successful completion of actions are green.
   - **Done (%)**—Percentage of migration completed.
   - **Source**—Source storage system.
   - **Target**—Target storage system.
   - **Valid Components**—Provides an icon that indicates whether any objects involved in the migration session are in an invalid state. The icon is green if all components are valid and red if any are invalid. You can find out what is
invalid by viewing the details of the migration. It provides a series of green or red icons representing the state of each object.

The following controls are available:
- **Cutover**—Cutting over a migration session on page 369
- **Commit**—Committing a migration session on page 370
- **View Details**—Viewing migration details on page 368
- **Recover**—Recovering a migration session on page 371
- **Sync**—Synchronizing data after non-disruptive migration (NDM) cutover on page 369
- **Cancel Migration**—Cancelling a migration session on page 370
- **Manage Environments**—Managing non-disruptive migration (NDM) environments on page 363

### Viewing migration details

This procedure explains how to view the migration details for a specific data migration. See **Understanding non-disruptive migration (NDM)** on page 362 for additional information.

To view the migration details:

**Procedure**

1. Select the storage system.
2. Select **Storage > Migrations**.
3. Select a storage group and click **View Details** to view the **Migrations details** view.

The following items are displayed:
- **Storage Group**—Name of the storage group.
- **State**—Migration state.
- **Source**—Source storage system.
- **Target**—Target storage system.
- **Capacity (GB)**—Capacity of the storage group in GB.
- **Synched Capacity (GB)**—Synchronized capacity of the storage group in GB.

A storage group table displaying the source status and target status for each storage group associated with the migration.

A masking view table displaying the source status and target status for each masking view associated with the migration.

A Port Group table. Selecting a row in the masking view table populates the Port Group table. The table displays the source status and target status for the selected masking view.

A Host/Host Group table. Selecting a row in the masking view table populates the Host/Host Group table. The table displays the source status and target status for the selected masking view.

Select an item in the Storage Group table to view the following volume information:
Cutting over a migration session

The cutover operation results in the storage array running HYPERMAX OS 5977 Q3 2016 or higher becoming the active array.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.

Before you begin:
To perform this procedure you must be an Administrator or Storage Admin.

The state of the migration session is CutoverReady.

To cutover a migration session:

Procedure

1. Select the storage system.
2. Select Storage > Migrations to display the Migrations list view.
3. Select a storage group and click Cutover.
   The Cutover dialog opens.
4. (Optional) Under the Show Advanced link you can select Force and/or SymForce.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Synchronizing data after non-disruptive migration (NDM) cutover

After cutover, the sync operation allows the synchronzation of the data between an array running HYPERMAX OS 5977 Q3 2016 or higher and an array running Enginuity 5876 Q3 2016 or higher.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.
Before you begin:
To perform this procedure you must be an Administrator or Storage Admin.
The state of the migration session is CutoverSync, CutoverSyncing or CutoverNoSync.
To start or stop the synchronization of a migration session:

Procedure
1. Select the storage system.
2. Select Storage > Migrations to display the Migrations list view.
3. Select a storage group and click Sync.
4. Click Stop to stop a synchronization or Start to start a synchronization.
5. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Committing a migration session
This procedure explains how to commit a data migration session.
See Understanding non-disruptive migration (NDM) on page 362 for additional information.
Before you begin:
To perform this procedure you must be an Administrator or Storage Admin.
The state of the migration session is CutoverSync or CutoverNoSync.
To commit a migration session:

Procedure
1. Select the storage system.
2. Select Storage > Migrations to display the Migrations list view.
3. Select a storage group and click Commit.
4. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Cancelling a migration session
This procedure explains how to cancel a data migration session (from the source or target array).
See Understanding non-disruptive migration (NDM) on page 362 for additional information.
Before you begin:
To perform this procedure you must be an Administrator or Storage Admin.
There are two cancel options. One of them is chosen by Unisphere depending on the migration session state.
The "Cancel without the revert flag" set operation requires the state of the migration session to be: Created, CreateFailed or CutoverReady.

The "Cancel with the revert flag" set operation requires the state of the migration session to be: Migrating or CutoverSync.

To cancel a migration session:

Procedure
1. Select the storage system.
2. Select Storage > Migrations to display the Migrations list view.
3. Select a storage group and click Cancel.
   A checkbox is displayed when Revert is being used and a dash is displayed when Revert is not being used.
4. (Optional) Select the SymForce check box.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Recovering a migration session

This procedure explains how to recover a data migration session from a failed state.

See Understanding non-disruptive migration (NDM) on page 362 for additional information.

Before you begin:
To perform this procedure you must be an Administrator or Storage Admin.

The state of the migration session is CreateFailed, CutoverFailed, CancelFailed, MigrFailed, or RevertFailed.

To recover a migration session:

Procedure
1. Select the storage system.
2. Select Storage > Migrations to display the Migrations list view.
3. Select a storage group and click Recover.
4. (Optional) Select Force under the Show Advanced section.
   The force flag is meant for cases where the state of the migration session is CreateInProg, CancelInProg, CutoverInProg, RevertInProg, or CommitInProg.
5. (Optional) Select SymForce under the Show Advanced section.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
Viewing migration details

This procedure explains how to view existing migration environments. You can also use this view to add a new migration environment or delete an existing one:

- Adding a migration environment
- Removing a migration environment

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > Migration Environments.

Adding a migration environment

Before you begin
To perform this procedure you must be a Storage Admin.

This procedure explains how to add a new migration environment.

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > Migration Environments.
3. Click the Setup button.
   The Setup Migration Environment window opens.
4. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Removing a migration environment

Before you begin
To perform this procedure you must be a Storage Admin.

This procedure explains how to remove a migration environment.

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > Migration Environments.
3. Select a migration environment in the list view and click the Remove button.
   The Remove Migration Environment window opens.
4. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
Understanding compression

Compression allows users to compress user data on storage groups and storage resources. The feature is enabled by default and can be turned on and off at storage group and storage resource level.

If a storage group is cascaded, enabling compression at this level enables compression for each of the child storage groups. The user has the option to disable compression on one or more of the child storage groups if desired.

To turn the feature off on a particular storage group or storage resource, uncheck the Compression check box in the in the Create Storage Group, Modify Storage Group or Add Storage Resource To Storage Container dialogs or when using the Provision Storage or Create Storage Container wizards.

The following are the prerequisites for using compression:

- Compression is only allowed on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.
- Compression is allowed for FBA devices only.
- The user must have at least StorageAdmin rights.
- The storage group needs to be FAST managed.
- The associated SRP cannot be comprised, either fully or partially, of external storage.

**Reporting**

Users are able to see the current compression ratio on the device, the storage group and the SRP. Efficiency ratios are reported in units of 1/10th:1.

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**Note**

External storage is not included in efficiency reports. For mixed SRPs with internal and external storage only the internal storage is used in the efficiency ratio calculations.

The following tasks explain how to view compression reporting details:

- Viewing the SRP efficiency details on page 373
- Viewing the Capacity Report on page 374
- Viewing a storage group's compression ratio on page 374
- Viewing a volume's compression details on page 375
- Viewing compression status using the VVols Dashboard on page 375

**Viewing the SRP efficiency details**

**Before you begin**

Users need to have at least Monitor rights.

This procedure explains how one way to view the overall efficiency details of an SRP. The Overall Efficiency Ratio field can also be viewed from the Storage Resource Pools Details view.
Procedure

1. Select a storage system.
2. Select Storage > Storage Groups Dashboard.

The following fields are displayed in the Storage Resource Pools panel:

- Overall Efficiency - The ratio of the sum of all TDEVs and Snapshot sizes and the Physical Used Storage (calculated based on the compressed pool track size).
- VP Ratio - The ratio of the sum of all TDEVs and Snapshot sizes and the sum of all TDEVs allocated plus RDP allocated space.
- Snapshot Ratio - The ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).
- Compression Ratio - The ratio of the backend storage (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).

Viewing the Capacity Report

Before you begin
Users need to have at least Monitor rights.

The following metrics are only available on VMAX All Flash arrays running HYPERMAX OS 5977 Q2 2017 SR or later:

- Total system capacity – Subscribed and used percent.
- Meta data – Replication and system used percent.

This procedure explains how to view the Capacity Report which is generated based on the thin devices in the system. You can view the efficiency of the system and of the SRPs in the system. The report can also be viewed by clicking the Overall Efficiency link on the Home Dashboard.

Procedure

1. Select a storage system.
2. Select Storage > Storage Groups Dashboard.
3. Click the Overall Efficiency link in the Storage Resource Pools panel to view the report.

See here for definitions of the items shown on the report: The Capacity Report on page 86

4. HYPERMAX OS 5977 Q2 2017 SR and later: On the System tab, you can get a more detailed breakdown of the capacity usage. Select Detailed View from the drop-down menu in the Array Usage panel.

Viewing a storage group's compression ratio

Before you begin
Users need to have at least Monitor rights to view the compression ratio.

This procedure explains how to view a storage group's compression ratio via the Storage Groups List View.
Procedure

1. Select a storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the COMPLIANCE panel, click Total to open the Storage Groups list view.
   The Compression Ratio column displays the compression ratio for each storage group.
4. Alternatively, select a storage group and click View Details.
   The Compression, Compression Ratio and VP Saved fields for the selected storage group are displayed.
   If compression is enabled on the storage group a tick will appear in the Compression field. If compression is disabled a horizontal dash will be shown.

Viewing a volume's compression details

Before you begin
Users need to have at least Monitor rights to view the compression ratio.
This procedure explains how to view a storage group volume's compression ratio.

Procedure

1. Select a storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the COMPLIANCE panel, click Total to open the Storage Groups list view.
4. Click on the Volumes related objects link.
5. Select a volume and click View Details.
   The Compression Ratio field for the selected volume is displayed. If compression ratio is not applicable on the volume the field will read "N/A."
6. Alternatively, select a storage system and then select Storage > Volumes List View.
7. Select a volume and click View Details.
   The Compression Ratio field for the selected volume is displayed.

Viewing compression status using the VVols Dashboard

Before you begin
Users need to have at least Monitor rights.
This procedure explains how to view the compression status and compression ratio of storage resources using the VVols Dashboard.

Procedure

1. Select a storage system.
2. Select Storage > VVols Dashboard.
   The compression state column for each storage resource is displayed in the Storage Resources Consumed Capacity - Subscribed panel. If compression is enabled a tick will appear in the Compression field. If compression is disabled a horizontal dash will be shown.
enabled for that resource a tick will appear in the column. If compression is disabled a horizontal dash will be shown.

3. To view the compression ratio on a storage resource, click on Storage Containers.
4. Select a storage container and click View Details.
5. Click on the Storage Resources link in the Related Objects panel.
6. Select a storage resource and click View Details.
The Compression Ratio field is displayed.

Viewing the compression efficiency dashboard

This procedure explains how to view the compression efficiency of a VMAX 3 array.

Procedure
1. Select Performance > Monitor > All Dashboards.
2. Select a VMAX 3 Symmetrix ID and choose Array as the category.
3. Click on the Efficiency tab.

Viewing compressibility reports

This procedure shows how to view maximum data compressibility of storage groups on a VMAX All Flash storage system. Compression must be enabled on the storage system.

Before you begin:
- This feature requires HYPERMAX OS 5977 Q2 2017 SR running on a VMAX All Flash storage system
- The account you use on Unisphere for VMAX must have Monitor privilege at least.

Procedure
1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.

The report lists the following details for each storage group:
- **Storage Group**—The name of the storage group.
- **# of Volumes**—The number of volumes in the group.
- **Allocated (GB)**—The amount of space allocated to the storage group.
- **Used (GB)**—The amount of allocated space that the group is using.
- **Target Ratio**—The expected compression ratio based on the last 24 hours of samples. If all storage groups are compressed, the compressibility report will be empty except for an entry named NOT_IN_SG (assuming that not all of the configured volumes are in storage groups).
CHAPTER 5
Host Management

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Creating hosts

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running Enginuity version 5876, or HYPERMAX OS 5977 or higher.
- The maximum number of initiators allowed in a host depends on the storage operating environment:
  - For Enginuity 5876, the maximum allowed is 32.
  - For HYPERMAX OS 5977 or higher, the maximum allowed is 64.

To create hosts:

Procedure

1. Select the storage system.
2. Select Hosts > Hosts.
3. Type a Host Name.
   
   Host names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Host names are case-insensitive.

4. Select the Fibre radio button to filter the available initiators table to display Fibre Channel initiators only or select the iSCSI radio button to filter the table to display iSCSI initiators only. The Fibre radio button is selected by default.

5. To add initiators to the host:
   a. specify the initiator by typing its name or by selecting it from the list.
   b. To filter the list, type part of a initiator name.
   c. Repeat this step for each additional initiator.

   Note
   Initiators can only belong to one host at a time; therefore, any initiators that do not appear in the list already belong to another host.

   d. Click Add.
   e. Repeat these steps for each additional initiator.

6. Optional: To set the host port attributes:
   a. Click Set Host Flags.
   b. Optional: Select a host whose flag settings you want to copy.
   c. Modify any of the attributes, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
   d. Optional: Select Consistent LUNs to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the
storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.

e. Click OK.

7. Do either of the following:
   - Click Run Now to start the task now.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

Adding initiators to hosts

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.
On storage systems running HYPERMAX OS 5977 or higher, iSCSI and fibre initiators cannot be mixed in the same host.

To add initiators to hosts:
Procedure

1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host and click View Details.
4. In the Related Objects panel, click Initiators.
5. Click Add Initiators.
6. Specify the initiator by typing its name or by selecting it from the list. The Initiators table is a filtered list based on whether the initiator is Fibre Channel or iSCSI. To filter the list, type part of the initiator name. Click Add. Repeat this step for each additional host.
7. Click OK.

Removing initiators from hosts

Before you begin
To perform this operation, you must be a StorageAdmin.
The VMAX array must be running Enginuity version 5876 or higher.

To remove initiators from hosts:
Procedure

1. Select the storage system.
2. Select Hosts > Initiators.
3. Select the host and click View Details.
4. In the Related Objects panel, click Initiators.
5. Select the initiator and click Remove.
6. Click OK.
Modifying hosts

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

Procedure
1. Select the storage system.
2. Select Hosts to open the Hosts list view.
3. Do one of the following:
   - Modifying hosts:
     - Select the host, click more, and select Modify to open the Modify Host dialog box.
     - To change the Host Name, highlight it and type a new name over it. Host names must be unique from other hosts on the Symmetrix system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.
   - Adding initiators:
     - In the Select Initiators list box, type the initiator name or select it from the list. To filter the list, type part of a initiator name.
     - Initiators can only belong to one host at a time; therefore, any initiators that do not appear in the list already belong to another host.
     - The Add Initiators table is a filtered list based on whether the host is Fibre Channel or iSCSI.
     - Click Add.
     - Repeat these steps for each additional initiator.
   - Removing initiators:
     - In the Initiators Added to Host list, select the initiator and click Remove.
     - Click OK.
     - Repeat these steps for each additional initiator.
4. Do either of the following:
   - Click Run Now to start the task now.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

Setting host or host group flags
To set host or host group flags:
**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select the host/host group, click more, and select **Set Flags**.
4. Optional: Select a host/host group whose flag settings you want to copy.
5. Modify any of the flags, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
6. Optional: Select **Consistent LUNs** to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.
7. Click **OK**.

**Renaming hosts/host groups**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To rename host/host groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select the host/host group, click more, and select **Delete**.
4. In the Properties panel, type a new name for the host/host group and click **Apply**.

Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host/host group names are case-insensitive.

**Deleting hosts/host groups**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To delete hosts/host groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select the host/host group from the list, click more, and click **View Details**.
4. Click **Delete**.

**Viewing hosts/host groups**

**Procedure**

1. Select **Hosts > Hosts** to open the Hosts list view.
2. Use the Hosts list view to view and manage hosts.

   The following properties display:
   - **Name**—Host/host group name. An arrow icon at the beginning of the name indicates that the host is a host group. Click the icon to view hosts contained in the group.
   - **Masking Views**—Number of masking view associated with the host.
   - **Initiators**—Number of initiators in the host.
   - **Consistent LUNs**—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.
   - **Port Flag Overrides**—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.
   - **Last Update**—Timestamp of the most recent changes to the host.

   The following controls are available:
   - **Create Host**—Creating hosts on page 378
   - **Create Host Group**—Creating host groups on page 388
   - **Provision Storage to Host**—Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91 or Using the Provision Storage wizard (Enginuity 5876) on page 100
   - **View Details**—Viewing host/host group details on page 382
   - **Modify**—Modifying hosts on page 380 or Modifying host groups on page 390
   - **Set Flags**—Setting host or host group flags on page 380
   - **Delete**—Deleting hosts/host groups on page 381

**Viewing host/host group details**

**Procedure**

1. Select **Hosts > Hosts**.
2. Select the host/host group and click **View Details**
3. Use the host Details view to view and manage hosts/host groups. This view contains two panels, **Properties** and **Related Objects**.
The properties and controls available in this panel depend on whether you are viewing details of an individual host or of host group, and on the storage operating environment.

The following properties display:

**Name**—Host/host group name. To rename the host/host group, type a new name over the existing and click Apply. Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.

**Number of Hosts**—Number of hosts in the group. This field only displays for host groups.

**Number of Host Groups**—Number of host groups in which this host is a member. This field only displays for individual hosts.

**Number of Initiators**—Number of initiators in the host/host group. For host groups, the value includes initiators in any child host groups.

**Number of Masking Views**—Number of masking views with which the host/host group is associated.

**Consistent LUNs**—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.

**Port Flag Overrides**—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.

**Enabled Port Flags**—List of any enabled port flags overridden by the host/host group.

**Disabled Port Flags**—List of any disabled port flags overridden by the host/host group.

**Last Update**—Timestamp of the most recent changes to the host/host group.

The following controls are available:

**Provision Storage to Host**—Using the Provision Storage wizard (Enginuity 5876) on page 100 or Using the Provision Storage wizard (Enginuity 5876) on page 100

**Modify**—Modifying hosts on page 380 or Modifying host groups on page 390

**Set flags**—Setting host or host group flags on page 380

**Delete**—Deleting hosts/host groups on page 381

**Apply**—Applies new host group name entered in the Name field.

**Cancel**—Cancels the rename action.

**Related Objects** panel

The **Related Objects** panel provides links to views for objects contained in or associated with the initiator group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding
Viewing host initiators

Procedure
1. Select Hosts > Hosts.
2. Select the storage system.
3. Select the host and click View Details.
4. From the Related Objects panel, click Initiators to open the host Initiators list view.

The following properties display:
- **Initiator**—WWN or IQN (iSCSI Qualified Name) ID of the initiator.
- **Alias**—User-defined initiator name.
- **Masking Views**—Number of associated masking views.

The following controls are available:
- **Add Initiator**—Adding initiators to hosts on page 379
- **Remove**—Removing initiators from hosts on page 379
- **View Details**—Viewing initiator details on page 402

Host/Host group flags

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Serial Number</td>
<td>Enables a unique serial number. This attribute is only available on storage systems running Enginuity 5773 or 5876.</td>
</tr>
<tr>
<td>Volume Set Addressing**</td>
<td>Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7 Where the first digit must always be set to 0 (storage system does not currently support the upper range of volume set addressing), the second digit is the VBus number, the third digit is the target, and the fourth digit is the LUN.</td>
</tr>
<tr>
<td>Avoid Reset Broadcast*</td>
<td>Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).</td>
</tr>
<tr>
<td>Environ Set*</td>
<td>Enables the environmental error reporting by the Symmetrix to the host on the specific port.</td>
</tr>
<tr>
<td>Disable Q Reset on UA</td>
<td>When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).</td>
</tr>
</tbody>
</table>
Table 5 Host/Host group flags (continued)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCSI 3*</td>
<td>Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix supports the SCSI-3 protocol. When disabled, the SCSI 2 protocol is supported.</td>
</tr>
<tr>
<td>SCSI Support1 (OS2007)*</td>
<td>Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0. To enable the SCSI Support1 attribute, you must also enable the SPC2 Protocol Version attribute.</td>
</tr>
<tr>
<td>SPC2 Protocol Version*</td>
<td>This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.</td>
</tr>
<tr>
<td>AS400</td>
<td>Indicates whether AS/400 is enabled. This attribute is only available on storage system’s running Enginuity 5773 - 5876.</td>
</tr>
<tr>
<td>Open VMS*,**</td>
<td>Enables an Open VMS fiber connection.</td>
</tr>
</tbody>
</table>

* To enable/disable this flag when it is already overridden (i.e., the Override option is already selected), you must:

Clear the Override option and click OK to close the dialog.

Open the dialog again, select Override, and then the desired state (Enable/Disable). Click OK.

** For storage systems running HYPERMAX OS 5977 or higher, if Volume Set Addressing is overridden and enabled, the Open VMS flag must be disabled. However, if you do not actually select the Open VMS override option, Solutions Enabler will override and disable it.

If the Open VMS flag is overridden and enabled, the Volume Set Addressing flag must be disabled. However, if you do not actually select the Volume Set Addressing override option, Solutions Enabler will automatically override and disable it.

Host I/O limits dialog box

Use this dialog box to set the host I/O limits for the storage group you are provisioning:

Procedure

1. Type values for one or both of the following:
   - **MB/Sec**—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
   - **IO/Sec**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec, in 100 increments.

2. To configure a dynamic distribution of host I/O limits, set Dynamic Distribution to one of the following; otherwise, leave this field set to Never (default). This feature requires Enginuity 5876.163.105 or higher.
   - **Always**—Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the
configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.

- **Failure**—Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.

3. Click **OK**.

**Note**

For more information on host I/O limits, refer to Setting host I/O limits on page 136.

---

### Host Group filtering rules

The host and host group list follows these guidelines for display:

| Initiators with the same name, but seen from different storage system login history tables will be filtered to only show once. New host groups can be set on both storage systems. |
| Initiators logged into one storage system but not another displays in the list, but will show up as logged out in the other storage system if they are added to the host. |
| If an Initiator is already in an host group on ALL of the storage systems where that initiator is logged in, then this initiator is filtered out of the Available list. Host groups with the same name and the same contents will be filtered to only show once. |
| If an initiator is not in an host group on one storage system, but it is in a host group on another storage system, both the initiator and the host group will be shown in the list. |
Select Storage Resource Pool

Use this dialog box to select a storage resource pool for the operation. Selecting None will remove the storage group from FAST control.

Provisioning VMAX storage

This section describes how to make VMAX storage available to hosts:

Viewing host alias details

Procedure

1. Select the storage system.
2. Select the host alias, and click View Details to open its Details view.
3. Use the host alias Details view to display and manage a host alias.
   
   This view contains two panels, Properties and Related Objects. The following properties display in the Properties panel:
   
   Host Alias Name — the name of the host alias.
   
   Number of Initiators — The number of masking records in the host alias.
   
   Number of Volumes — The number of volumes masked to the initiators.
   
   The following controls are available in the Properties panel:
   
   Mask —
   
   Set Flags —
Delete Host Alias —

The Related Objects panel provides links to views for objects contained in and associated with the host alias. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Initiators - 2 opens a view listing the two initiators in the host alias.

Viewing host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases to open the Host Aliases list view.
3. Use the Host Aliases list view to display and manage host aliases.
   The following properties display:
   - Host Alias Name — The name of the host alias.
   - Number of Initiators — The number of masking records in the host alias.
   - Number of Volumes — The number of volumes masked to the initiators.
   The following controls are available:
   - Mask — Masking volumes on page 398
   - Create — Creating host aliases on page 441
   - Set Flags — Setting initiator port flags on page 400
   - View Details — Viewing host alias details on page 387
   - Delete Host Alias — Deleting host aliases on page 442

Creating host groups

Before you begin
To perform this operation, you must be a StorageAdmin.

The storage system must be running Enginuity version 5876, or HYPERMAX OS 5977 or higher.

The maximum number of hosts allowed in a host group depends on the HYPERMAX OS:
For Enginuity 5876, the maximum allowed is 32.
For HYPERMAX OS 5977 or higher, the maximum allowed is 64.

This procedure explains how to create a host group (collection of hosts). For instructions on creating a host, refer to Creating hosts on page 378.

To create host groups:

Procedure
1. Select the storage system.
2. Select Hosts > Hosts .
3. Click Create Host Group.
4. Type a Host Group Name.
Host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host group names are case-insensitive.

5. Select the Fibre radio button to filter the available hosts table to display Fibre Channel hosts only or select the iSCSI radio button to filter the table to display iSCSI hosts only. The Fibre radio button is selected by default.

6. Optional: Do one of the following:
   - To create new hosts to add to the group, click Create New Host. For instructions on creating hosts, refer to Creating hosts on page 378.
   - To add existing hosts to the group:
     - Specify the host by typing its name or by selecting it from the list.
     - To filter the list, type part of the host name.
     - Repeat this step for each additional host.
     - Click Add.
   - Repeat these steps for each additional host.
   - To set the host port attributes:
     - Click Set Host Group Flags to open the Set Host/Host Group Flags dialog box.
     - Optional: Select a host whose flag settings you want to copy.
     - Modify any of the attributes, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
   - Optional: Select Consistent LUNs to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.

7. Click OK.

8. Do either of the following:
   - Click Run Now to start the task now.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

**Adding hosts to host groups**

**Before you begin**
To perform this operation, you must be a StorageAdmin.

The storage system must be running Enginuity version 5876 or HYPERVMAX OS 5977 or higher.

To add hosts to host groups:

**Procedure**

1. Adding hosts to host groups:
2. Select the storage system.
3. Select Hosts > Hosts.
4. Select the host group (or empty host) and click View Details.
5. In the Related Objects panel, click Hosts.
6. Click Add Hosts.
7. Specify the host by typing its name or by selecting it from the list. The hosts table is a filtered list based on whether the host selected is Fibre Channel or ISCSI. To filter the list, type part of the host name. Click Add. Repeat this step for each additional host.
8. Click OK.

Removing hosts from host groups

Before you begin
To perform this operation, you must be a StorageAdmin.
The VMAX array must be running Enginuity version 5876 or higher.

To add hosts to host groups:

Procedure
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host group and click View Details.
4. In the Related Objects panel, click Hosts.
5. Select the host and click Remove.
6. Click OK.

Modifying host groups

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

Modifying host groups:

Procedure
1. Select the storage system.
2. Do one of the following:
   i. To modify a host group:
      ▪ Select the host group, click more \( \rightarrow \), and select Modify
      ▪ To change the host group Name, highlight it and type a new name over it.
      Host names must be unique from other hosts on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.
   ii. To add a Host:
      ▪ Optional: To create a new host to add to the group, click Create New Host. For help, refer to Creating hosts on page 378.
      ▪ Select the host and click Add. To filter the list, type part of the host name. Repeat this step for each additional host.
To remove a Host:
- In the list of hosts, select the host and click **Remove**.
- Click **OK**.

3. Repeat these steps for each additional host.

4. Do either of the following:
   - Click **Run Now** to start the task now.
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.

### Renaming hosts/host groups

**Before you begin**
To perform this operation, you must be a Storage Admin.
The storage system must be running Enginuity version 5876 or higher.

To rename host/host groups:

**Procedure**
1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Select the host/host group, click **Delete**, and select **Delete**.
4. In the Properties panel, type a new name for the host/host group and click **Apply**.

Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host/host group names are case-insensitive.

### Setting host or host group flags

To set host or host group flags:

**Procedure**
1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Select the host/host group, click **Set Flags**, and select **Set Flags**.
4. Optional: Select a host/host group whose flag settings you want to copy.
5. Modify any of the flags, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
6. Optional: Select **Consistent LUNs** to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.
7. Click OK.

Deleting hosts/host groups

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To delete hosts/host groups:

Procedure
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host/host group from the list, click more... and click View Details.
4. Click Delete.

Viewing hosts/host groups

Procedure
1. Select Hosts > Hosts to open the Hosts list view.
2. Use the Hosts list view to view and manage hosts.
   The following properties display:
   - Name—Host/host group name. An arrow icon at the beginning of the name indicates that the host is a host group. Click the icon to view hosts contained in the group.
   - Masking Views—Number of masking view associated with the host.
   - Initiators—Number of initiators in the host.
   - Consistent LUNs—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.
   - Port Flag Overrides—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.
   - Last Update—Timestamp of the most recent changes to the host.

The following controls are available:
- Create Host—Creating hosts on page 378
- Create Host Group—Creating host groups on page 388
- Provision Storage to Host—Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91 or Using the Provision Storage wizard (Enginuity 5876) on page 100
- View Details—Viewing host/host group details on page 382
- Modify—Modifying hosts on page 380 or Modifying host groups on page 390
- Set Flags—Setting host or host group flags on page 380
Viewing host/host group details

Procedure

1. Select Hosts > Hosts.
2. Select the host/host group and click View Details.
3. Use the host Details view to view and manage hosts/host groups. This view contains two panels, Properties and Related Objects.

Note

The properties and controls available in this panel depend on whether you are viewing details of an individual host or of host group, and on the storage operating environment.

The following properties display:

**Name**—Host/host group name. To rename the host/host group, type a new name over the existing and click Apply. Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.

**Number of Hosts**—Number of hosts in the group. This field only displays for host groups.

**Number of Host Groups**—Number of host groups in which this host is a member. This field only displays for individual hosts.

**Number of Initiators**—Number of initiators in the host/host group. For host groups, the value includes initiators in any child host groups.

**Number of Masking Views**—Number of masking views with which the host/host group is associated.

**Consistent LUNs**—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✔ indicates that the feature is set.

**Port Flag Overrides**—Flag indicating if any port flags are overridden for the host. ✔ indicates that there are overridden port flags.

**Enabled Port Flags**—List of any enabled port flags overridden by the host/host group.

**Disabled Port Flags**—List of any disabled port flags overridden by the host/host group.

**Last Update**—Timestamp of the most recent changes to the host/host group.

The following controls are available:

**Provision Storage to Host**—Using the Provision Storage wizard (Enginuity 5876) on page 100 or Using the Provision Storage wizard (Enginuity 5876) on page 100.

**Modify**—Modifying hosts on page 380 or Modifying host groups on page 390.
Set flags—Setting host or host group flags on page 380
Delete—Deleting hosts/host groups on page 381
Apply—Applies new host group name entered in the Name field.
Cancel—Cancels the rename action.

Related Objects panel
The Related Objects panel provides links to views for objects contained in or associated with the initiator group. Each group link is followed the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking Initiators - 2 opens the view listing the two initiators contained in the initiator group.

Viewing hosts in host groups

Procedure
1. Select the storage system.
2. Select Hosts > Hosts to open the Hosts list view.
3. In the Related Objects panel, click Hosts to open the host group - Hosts list view.
4. Use the host group - Hosts list view to view and manage hosts in the host group.

The following properties display:
Name—Host/host group name.
Masking Views—Number of masking view associated with the host.
Initiators—Number of initiators in the host.
Consistent LUNs—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. indicates that the feature is set.
Port Flag Overrides—Flag indicating if any port flags are overridden for the host. indicates that there are overridden port flags.
Last Update—Timestamp of the most recent changes to the host.

The following controls are available:
Add Hosts—Adding hosts to host groups on page 389
Remove—Removing hosts from host groups on page 390
Set flags—Setting host or host group flags on page 380
View Details—Viewing host/host group details on page 382

Creating masking views

Before you begin
The following explains how to mask volumes on storage systems running Enginuity 5876 or higher. For instructions on masking volumes on storage systems running Enginuity 5773, refer to Masking volumes on page 398.
To create a masking view, you need to have created initiator groups, port groups, and storage groups. For instructions, refer to Creating port groups on page 406, and Creating storage groups (Enginuity 5876) on page 111.

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking view** list view.
3. Click **Create Masking View** to open the Create Masking View dialog box.
4. Type the **Masking View Name**.
   
   Masking view names must be unique from other masking views on the array and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Masking view names are case-insensitive.
5. Select the **Host**.
6. Select the **Port Group**.
7. Select the **Storage Group**.
8. **Optional:** Manually set the host LUN addresses:
   a. Click **Set Dynamic LUNs** to open the Set Dynamic LUN Address dialog box.
   b. Select a volume, and notice the address displayed in the **Starting LUN** field.
      
      To accept this automatically generated address, click **Apply Starting LUN**.
      
      To move to the next available, click **Next Available LUN**.
   c. Click **OK** to close the Set Dynamic LUN Address dialog box.
9. Click **OK**.

**Renaming masking views**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking Views** list view.
3. Select the masking view from the list and click **View Details** to open the Details view.
4. Type the new **Name**, and click **Apply**.
   
   Masking view names must be unique from other masking views on the array and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Masking view names are case-insensitive.

**Deleting masking views**

This procedure explains how to delete masking views from the **Masking Views** list view. In eNAS operating environments, you can also perform this operation from the File Masking Views page (System > System Dashboard > File Dashboard > File Masking Views).

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking View** list view.
3. Select the masking view from the list, click **Delete** to open the Delete Masking View confirmation dialog box.
4. To unmap volumes in the masking view from their mapped ports, select **Unmap**.
5. Click **OK**.

### Viewing masking views

**Procedure**

1. Select the storage system.
2. Do one of the following:
   - Select **Hosts > Masking view** to open the **Masking Views** list view.
   - Select **Storage > VVols Dashboard > PE Masking Views** to open the PE **Masking Views** list view.

Use the **Masking view** list view to view and manage masking views.

The following properties display:

- **Name**— User-defined masking view name.
- **Host**— Name of the associated host.
- **Port Group**— Name of the associated port group.
- **Storage Group**— Name of the associated storage group.

Depending on the options chosen, some of the following controls are available:

- **Create Masking View**—Creating masking views on page 394
- **Provision PE to Host**—Provisioning protocol endpoints to hosts on page 360
- **View Connections**—Viewing masking view connections on page 396
- **Delete**—Deleting masking views on page 395
- **View Details**—Viewing masking view details on page 397

### Viewing masking view connections

This procedure explains how to perform the operation from the **Masking Views** list view. In eNAS operating environments, you can also perform this operation from the **File Masking Views** page (**System > System Dashboard > File Dashboard > File Masking Views**).

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking Views** to open the **Masking Views** list view.
3. Select the masking view from the list and click **View Connections** to open the masking view connections view.

Use the **Masking View** view to filter a masking view by selecting various combinations of members within a group (initiators, ports, volumes) and display the masking view details from the group level to the object level.

Filtering a masking view

The **Masking view** view contains three tree view lists for each of the component groups in the masking view, initiator groups, ports groups, and storage groups.
The parent group is the default top-level group in each expandable tree view and contains a list of all components in the masking group including child entries which are also expandable.

To filter the masking view, single or multi-select (hold shift key and select) the items in the list view.

As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.

**Filtered results table**

The following properties display:

- **LUN Address**
  - LUN address number.

- **Volume**
  - Symmetrix system volume number.

- **Capacity (GB)**
  - Capacity, in GB, of the volume.

- **Initiator**
  - WWN or IQN (iSCSI Qualified Name) ID of the initiator.

- **Alias**
  - Alias of the initiator.

- **Director:Port**
  - Symmetrix system director and port in the port group.

- **Logged In**
  - Indicates if the initiator is logged into the host/target.

- **On Fabric**
  - Indicates if the initiator is zoned in and on the fabric.

The following additional filters are available to filter the results table:

- **Show Logged In**
  - Shows only the entries for LUNs where the associated initiator is logged in.

- **Show On Fabric**
  - Shows only the entries for LUNs where the associated initiator is zoned in and on the fabric.

## Viewing masking view details

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking Views** list view.
3. Select the masking view from the list and click **View Details** to open the **Details** view.

Use the **Details** view to view and manage masking views. This view contains two panels, **Properties** and **Related Objects**.

The following properties display:
Name
User-defined masking view name.

Host
Name of the associated host.

Number of initiators
Number of initiators in the masking view. This is the number of primary initiators contained in the masking view and does not include any initiators included in cascaded initiator groups that may be part of the masking view.

Port Group
Name of the associated port group.

Number of ports
Number of ports contained in the masking view.

Storage Group
Name of the associated storage group.

Number of volumes
Number of volumes in the storage group contained in the masking view.

Capacity (GB)
Total capacity, in GB, of all volumes in the masking view.

The following controls are available:

- **Delete**—Deleting masking views on page 395
- **Apply**—Applies changes made in the Properties list. For example, renaming the masking view.
- **Cancel**— Cancels changes made in the Properties list.

Related Objects panel:
The Related Objects panel provides links to views for objects contained in or associated with the masking view. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking **Volumes - 2** opens the view listing the two volumes associated with the masking view.

Masking volumes

The following explains how to mask volumes on storage systems running Enginuity 5773. For instructions on masking volumes on storage systems running Enginuity 5876 or higher, refer to Creating masking views on page 394.

You can perform this operation at the initiator or host alias level.

To mask volumes:

**Procedure**

1. Select the storage system.
2. To mask at the initiator level:
a. Select **Hosts > Initiators** to open the **Initiators** list view.

b. Select an initiator, and click **Mask** to open the Masking dialog box.

3. To mask at the host alias level:
   a. Select **Hosts > Host Aliases**
   b. Select a host alias, and click **Mask**

4. Optional: Select another Director Port for the operation. (One director at a time.)

5. Optional: Select another Initiator/Alias for the operation. (One director at a time.)

6. Optional: Select to Include volumes not mapped to the port in the Available Volumes list.

7. Select one or more Available Volumes, and click **Add** to move them to Selected Volumes, or click **Add All** to move all Available Volumes to the Selected Volumes.

8. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - **Show Advanced** to set the advanced options.

To manually set the host LUN addresses:

- Select the **Dynamic LUN Addressing** option.
- Click **Set Dynamic LUN Address**.
- Select a volume, and notice the address displayed in the Starting Host LUN field. To accept this automatically generated address, click Apply Starting LUN. To move to the next available, click Next Available LUN.
- Click OK once you are satisfied with the address.

To automatically map new volumes to all ports, select **Map Volumes**. (This feature is only available on Symmetrix DMX systems running Enginuity 5773.150 or higher.)

To refresh all the host-related profile data in the volume masking database (VCMDB), select **Refresh VCMDB** after **OK**. Click **OK** (This option is only available on storage systems running Enginuity 5773.)

### Unmasking volumes

The following explains how to unmask volumes on storage systems running Enginuity 5773.

You can perform this operation at the initiator or host alias level.

**Procedure**

1. Select the storage system.

2. To unmask at the initiator level:
   a. Select **Hosts > Initiators**.
   b. Select the initiator from the list, and click **View Details**.
c. In the Related Objects panel, select Volumes.

3. To unmask at the host alias level:
   a. Select the alias and and click View Details.
   b. In the Related Objects panel, select Volumes
   c. Select a volume, and click Unmask.
   d. Optional: Click Show Select Volumes to view details on the selected volumes.
   e. To unmap the volumes from their ports, select Unmap Volumes.

4. To refresh all the host-related profile data in the volume masking database (VCMDB), select Refresh VCMDB after OK.
   This option is only available on storage systems running Enginuity 5773.

5. Click OK.

Setting initiator port flags

Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3. Select an initiator and click Set Flags.
4. Optional: Select an initiator whose flag settings you want to copy.
5. Modify the attributes, by selecting the corresponding Override option (thereby activating the Enable option), and enable (select) or disable (clear) the flag.
6. Click OK.

Setting initiator attributes

Before you begin
Any changes made to an initiator's attributes affect the initiator and all its ports.

To set initiator attributes:

Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3. Select an initiator and click Set Attributes.
   The initiator director: port, initiator, and optional alias names display.
4. Type the FCID (Fibre Channel ID) Value.
5. To refresh all the host-related profile data in the volume masking database (VCMDB), select Refresh VCMDB after OK.
   This option is only available on storage systems running Enginuity 5773.
6. Click OK.
Renaming initiator aliases

When the system discovers the attached HBAs, a two-part record is created for the name. The format is NodeName/PortName. For fiber adapters, the HBA name is the WWN or iSCSI name. For native iSCSI adapters, the HBA name is the IP address.

You can rename the HBA identifier by creating a shorter, and easier to remember, ASCII alias name.

To rename an initiator alias:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Initiators**.
3. Select an initiator, and click **Rename Alias**.
4. Type a Node Name and Port Name.
   - On storage systems running Enginuity 5876, node and port names cannot exceed 16 characters.
   - On storage systems running HYPERMAX OS 5977 or higher, node and port names cannot exceed 32 characters.
5. Click **OK**.
   - This overwrites any existing alias name.

Replacing initiators

If a host adapter fails, or needs replacement for any reason, you can replace the adapter and assign its set of volumes to a new adapter.

To replace an initiator:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Initiators**.
3. Select the initiator, and click **Replace Initiator**.
   - The existing initiator and optional alias names display.
4. Type the full WWN or iSCSI identifier of the New Initiator. For native iSCSI, type the IP address.
5. Click **OK**.
   - This substitutes all occurrences of the old WWN/iSCSI/IP address with the new one.

Removing masking entries

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Initiators**.
3. Select the initiator, click more **>>**, and select **Remove Masking Entry** to open the **Remove Masking Entry** dialog box.
4. Select the director and port.

5. Optional: To remove the entry from the storage system login history tables, select Include login history.

   This option is only available on storage systems running Enginuity 5773.

6. Optional: To refresh all the host-related profile data in the volume masking database (VCMDB), select Refresh VCMDB after OK.

   This option is only available on storage systems running Enginuity 5773.

7. Click OK.

Viewing initiators

Procedure

1. Select the storage system.

2. Use the Initiators list view to view and manage initiators.

   The properties and controls displayed in the view vary depending on the Enginuity version running on the storage system and on how you arrived at this view.

   Initiator — WWN or IQN (iSCSI Qualified Name) ID of the initiator.

   Dir:Port — Storage system director and port associated with the initiator, for example: FA-7E:1.

   Alias — User-defined initiator name.

   Logged In — Flag indicating if the initiator is logged into the fabric: Yes/No.

   On Fabric — Flag indicating if the initiator is on the fabric: Yes/No.

   Port Flag Overrides — Flag indicating if any port flags are overridden by the initiator: Yes/No.

   Hosts — Number of hosts the initiator is associated with

   Masking Views — Number of masking views the initiator is associated with, including the masking views that are associated with any cascaded relationships. This field only applies/appears for storage systems running Enginuity 5876 or higher.

   The following controls are available:

   Set Host Flags — Setting initiator port flags on page 400

   Set Attributes — Setting initiator attributes on page 400

   Rename Alias — Renaming initiator aliases on page 401

   Replace Initiator — Replacing initiators on page 401

   View Details — Viewing initiator details on page 402

   Removing Masking Entry — Removing masking entries on page 401

Viewing initiator details

Procedure

1. Select the storage system.

2. Select Hosts > Initiators.

3. Select the initiator from the list, and click View Details.
4. Use the **Initiator** details view to view and manage initiators.

This view contains two panels:

**Properties panel**

The properties and controls displayed in the view vary depending on the
Enginuity version running on the storage system and on how you arrived at this
view.

- **Initiator**—WWN or IQN (iSCSI Qualified Name) ID of the initiator.
- **Dir:Port**—Storage system director and port associated with the initiator, for example: FA-7E:1
- **Alias**—The user-defined initiator name.
- **Number of Hosts**—Number of hosts.
- **Number of Initiator Groups**—Number of associated initiator groups, including
  the immediate initiator group and any parent initiator groups that include this
  initiator group. This field only applies/appears for Symmetrix systems running
  Enginuity 5876 or higher.
- **Number of Masking Views**—Number of associated masking views, including
  the masking views that are associated with any cascaded relationships. This
  field only applies/appears for storage systems running Enginuity 5876 or higher.
- **Logged In**—Flag indicating if the initiator is logged into the fabric: Yes/No.
- **On Fabric**—Flag indicating if the initiator is on the fabric: Yes/No.
- **Port Flag Overrides**—Flag indicating if any port flags are overridden by the
  initiator: Yes/No.
- **Enabled Flags**—List of any enabled port flags overridden by the initiator.
- **Disabled Flags**—List of any disabled port flags overridden by the initiator.
- **Flags in Effect**—Flags that are in effect for the initiator.
- **Last Login**—Timestamp for the last time this initiator was logged into the
  system.
- **FCID**—Fibre Channel ID for the initiator.
- **FCID Value**—Value that is enabled for FCID lockdown.
- **FCID Lockdown**—Flag indicating if port lockdown is in effect: Yes/No.
- **IP Address**—IP address for the initiator.
- **LUN Offset**—Whether LUN offset is enabled. This feature allows you to skip
  over masked holes in an array of volumes.
- **Offset Value**—Number of address spaces required to skip over the hole.
- **Base Value**—Host's first missing LUN in the skip hole.
- **Dynamic Addressing**—Whether dynamic LUN addressing is enabled. With this
  feature, the system assigns the address based on availability.

The following controls are available:

- **Mask**—Masking volumes on page 398
- **Set Flags**—Setting initiator port flags on page 400
- **Set Attributes**—Setting initiator attributes on page 400
- **Rename Alias**—Renaming initiator aliases on page 401
- **Replace Initiator**—Replacing initiators on page 401
Removing Masking Entry—Removing masking entries on page 401

Related Objects panel

The Related Objects panel provides links to views for objects contained in or associated with the initiator. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Initiators Groups- 1 opens the view listing the initiator group that contains the initiator.

Viewing initiator details from initiator group

Procedure

1. Select the storage system.
2. Select Hosts > Host to open the Hosts list view.
3. Select the host group and click View Details to open the host group Details view.
4. From the Related Objects panel, click Hosts to open the Hosts list view.
5. Select a host and click View Details to open the host Details view.
6. From the Related Objects panel, click Initiators to open the host Initiators list view.
7. Select the initiator and click View Details to open the initiator Details view.
8. Use the initiator Details view to view initiator properties.

Use the initiator Details view to view initiator properties.

The following properties display, depending on the Enginuity version running on the storage system:

**Initiator**—WWN or IQN (iSCSI Qualified Name ) ID of the initiator.

**Alias**—The user-defined initiator name.

**Port Flag Overrides**—Flag indicating if any port flags are overridden by the initiator.

**Enabled Flags**—List of any enabled port flags overridden by the initiator.

**Disabled Flags**—List of any disabled port flags overridden by the initiator.

**FCID Value**—Value that is enabled for FCID lockdown.

**Number of Hosts**—Number of associated hosts, including the immediate host group and any parent host groups that include this host group. This field only applies/appears for storage systems running Enginuity 5876 or higher.

**Number of Masking Views**—Number of associated masking views, including the masking views that are associated with any cascaded relationships. This field only applies/appears for storage systems running Enginuity 5876 or higher.

Viewing volumes associated with host initiator

Procedure

1. Select the storage system.
2. Select Hosts > Initiators.
3. Select the initiator from the list and click View Details.
4. In the Related Objects panel, select Volumes.
5. Use this view to view and manage volumes associated with the initiator.
   
   The following properties display:
   
   **Name**—Volume name.
   
   **Allocated %**—% of space allocated.
   
   **Pool State**—State of the pool.
   
   **Name**—Volume name.
   
   **Capacity (GB)**—Volume capacity in GBs.
   
   **Host Paths**—Number of host paths.
   
   **Status**—Volume status.
   
   **Reserved**—Whether the volume is reserved.
   
   **Emulation**—Volume emulation.
   
   **Pinned**—Indicates whether the volume is pinned.
   
   The following controls are available, depending on the Enginuity version running on the storage system:
   
   **Create**—Creating volumes on page 205
   
   **View Details**—Viewing details on a volume in a storage group on page 156
   
   **Tag for Recover Point**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584
   
   **Untag for Recover Point**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584
   
   **Map**—Mapping volumes on page 221
   
   **Unmap**—Unmapping volumes on page 222
   
   **VLUN Migration**—VLUN Migration dialog box on page 321
   
   **Bind**—Binding/Unbinding/Rebinding thin volumes on page 315
   
   **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 315
   
   **Rebind**—Binding/Unbinding/Rebinding thin volumes on page 315
   
   **Change Volume Configuration**—Changing volume configuration on page 219
   
   **Set Volume Attributes**—Setting volume attributes on page 224
   
   **Duplicate Volume**—Duplicating volumes on page 217
   
   **Set Volume Identifiers**—Setting volume identifiers on page 225
   
   **Set Volume Status**—Setting volume status on page 223
   
   **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 234
   
   **Assign Symmetrix Priority**—Assigning Symmetrix priority to individual volumes on page 218
   
   **Start Allocate/Free/Reclaim**—Start Allocate/Free/Reclaim dialog box on page 313
   
   **Stop Allocate/Free/Reclaim**—Stop Allocate/Free/Reclaim dialog box on page 313
   
   **Replication GoS**—QOS for replication on page 235
   
   **Pin**—Pinning and unpinning volumes on page 192
Unpin—Pinning and unpinning volumes on page 192

Viewing details of a volume associated with initiator

Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3. Select the initiator from the list and click View Details.
4. In the Related Objects panel, click Volumes.
5. Select the volume from the list and click View Details.

The Details view allows you to view and manage a volume. This view contains two panels: Properties and Related Objects.

For descriptions of the properties displayed and Related Objects panel refer to Viewing volume details on page 278.

The following controls are available:

Create—To select the type of volume to create refer to Creating volumes on page 205.

More controls—To access the controls for a volume type refer to Viewing volume controls on page 279.

Creating port groups

Before you begin
Note the following recommendations:

Port groups should contain four or more ports.
Each port in a port group should be on a different director.

A port can belong to more than one port group. However, for storage systems running HYPERMAX OS 5977 or higher, you cannot mix different types of ports (physical FC ports, virtual ports, and iSCSI virtual ports) within a single port group.

Creating port groups:

Procedure
1. Select the VMAX system.
2. Select Hosts > Port Groups.
3. Click Create Port Group.
4. Type a Port group name.

Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Port group names are case-insensitive.

5. Select the appropriate filter to filter the port list by iSCSI or FC.
6. Select the available ports from the Ports list, and click Add to add them to the Ports to add list.

The following properties display:

Dir:Port—Storage system director and port in the port group.
Deleting port groups

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. There are two ways to delete a Port Group, from the Port Groups list view or from the Port Group Details view.
4. Select the port group and click Delete to open the Delete Port Group confirmation message.
5. For mapped ports only: Select Unmap.
6. Click OK.

Adding ports to port groups

Before you begin
Note the following recommendations:
Port groups should contain four or more ports.
Each port in a port group should be on a different director.
A port can belong to more than one port group. However, for storage systems running HYPERMAX OS 5977 or higher, you cannot mix different types of ports (physical FC ports, virtual ports, and iSCSI virtual ports) within a single port group.

Adding ports to port groups:

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click View Details
4. From the Related Objects panel, click Ports
5. Click Add Ports.
   If the port group already contain FC ports, the dialog is populated with all available FC ports. If the port group already contain iSCSI ports, this dialog is populated with all available iSCSI ports. If there are no ports in the port group, select the appropriate filter to filter the port list by iSCSI or FC.
6. Select the available ports from the Ports to add list, and click Add Ports to add them to the Ports to Add list.
The following properties display:
Dir:Port—Storage system director and port in the port group.
**Identifier**—IQN of an iSCSI target or WWN of an FC port.

**Ports Groups**—Number of port groups where the port is a member.

**Masking Views**—Number of associated masking views.

**Volumes**—Number of associated volumes.

**VSA Flag**—Indicates if a VSA flag is present.

7. Click **OK**.

### Removing ports from port groups

**Before you begin**

Note the following recommendations:

Port groups should contain four or more ports.

Each port in a port group should be on a different director.

To remove ports from port groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.
3. Select the port group and click **View Details**.
4. From the **Related Objects** panel, click **Ports**.
5. Select the port to remove or hold down the shift key to multi-select the ports to be removed from the port group.
6. Click **Remove** to open the Remove Ports confirmation message.
7. For mapped ports only: You can optionally select to Unmap any affected volumes from their respective ports.
8. Click **OK**.

### Renaming port groups

To rename port groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.
3. Select the port group and click **View Details**.
4. Type the new port group Name and click **Apply**.

### Viewing port groups

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups** to open the **Port Groups** list view.

The **Port Groups** list view allows you to view and manage port groups on a storage system.

There are multiple ways to open this view. Depending on the one you used, some of the following properties and controls may not appear.
The following properties display (Click a column heading to sort the list by that value):

**Name**—User-defined port group name, accompanied by an icon indicating the port group type. Possible types are:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌟</td>
<td>Standalone port group</td>
</tr>
<tr>
<td>🎈</td>
<td>Port group in masking view</td>
</tr>
</tbody>
</table>

**Ports**—Number of ports in the group.

**Masking Views**—Number of masking views where the port group is associated.

**Last Update**—Timestamp of the most recent changes to the port group.

The following controls are available:

- **Create Port Group**—[Creating port groups](#) on page 406
- **View Details**—[Viewing port groups details](#) on page 409
- **Delete**—[Deleting port groups](#) on page 407

**Viewing port groups details**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.
3. Select the port group and click **View Details**.
4. Use the port groups Details view to view and manage a port group. This view contains two panels, **Properties** and **Related Objects**.

**Properties panel**

The following properties display (Click a column heading to sort the list by that value):

**Name**—User-defined port group name.

**Number of Ports**—Number of ports in the group.

**Number of Masking Views**—Number of masking views where the port group is associated.

**Last Update**—Timestamp of the most recent changes to the port group.

**Host I/O Limit (IO/Sec)**—Total host I/O limit on the specified port group in IO/Sec. Zero indicates that there is no limit set.

**Host I/O Limit (MB/Sec)**—Total host I/O limit on the specified port group in MB/Sec. Zero indicates that there is no limit set.

**Negotiated Speed (MB/Sec)**—Bandwidth in MB/sec for that port group (that is, the aggregated port negotiated speed for the ports in the group).

**Percent Capacity**—Percentage of the bandwidth demand over the port group negotiated speed.

**Excess (MB/Sec)**—Amount of bandwidth in MB/sec that is left available on the port group after the host I/O limits have been accounted for.

The following controls are available:
Delete—Deleting port groups on page 407

Apply—Applies changes made in the Properties list, for example, renaming the port group.

Cancel—Cancels changes made in the Properties list.

Related Objects panel
The Related Objects panel provides links to views for objects contained in or associated with the port group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking Host I/O Limits - 2 opens the view listing the host I/O limits set for the two storage groups associated with the port group.

Viewing ports in port group

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click View Details.
4. From the Related Objects panel, click Ports.
5. Use the Ports list view to view and manage ports.

The following properties are displayed:

Dir:Port—Storage system director and port in the port group.

Identifier—IQN of an iSCSI target or WWN of an FC port.

Port Groups—Number of port groups where the port is a member.

Masking Views—Number of masking views where the port is associated.

Mapped Volumes—Number of volumes mapped to the port.

The following controls are available:

Add Ports—Adding ports to port groups on page 407

Remove—Removing ports from port groups on page 408

View Details—Viewing port details on page 410

Viewing port details

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click View Details.
4. From the Related Objects panel, click Ports.
5. Select a port and click View Details.
6. Use the port Details view to view and manage a port.

This view contains two panels, Properties and Related Objects.

Properties panel
The following properties display:

Dir:Port—Storage system director and port in the port group.
**Identifier**—IQN of an iSCSI target or WWN of an FC port.

**Number of Port Groups**—Number of port groups where the port is a member.

**Number of Masking Views**—Number of masking views where the port is associated.

**Number of Masked Volumes**—Number of volumes visible through the port.

**Number of Mapped Volumes**—Number of volumes mapped to the port, including meta members.

**Volume Set Addressing**—Whether volume set addressing is on or off.

**Port Status**—Whether the port is online or offline.

**Number of IP Interfaces**—Number of IP interfaces associated with the iSCSI target.

**Number of iSCSI Ports**—Number of physical iSCSI ports associated with IP interfaces which are in turn attached to the iSCSI target.

**Related Objects** panel

The Related Objects panel links you to views displaying objects associated with the port. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Masking Views - 2** opens a view listing the two masking views associated with the port.

### Volume Set Addressing

An addressing scheme that uses virtual busses, targets, and LUNs to increase greatly the number of LUNs that can be addressed on a target port. Volume Set Addressing is supported for HP-UX.

### Viewing host IO limits

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.
3. Select the port group and click **View Details**.
4. In the Related Objects panel, click **Host I/O Limits**.

The following properties display:

**Storage Group**—Storage group on which the limit is set.

**Quota State**—Whether the limit is set directly on the storage group (Defined) or through a cascaded relationship (Shared).

**Dir:Port**—Storage system director and port in the port group.

**Host I/O Limit (MB/Sec)**—Total host I/O limit on the listed port in MB/Sec. This value is the associated port group’s I/O limit divided across its ports.

**Host I/O Limit (IO/Sec)**—Total host I/O limit on the listed port in IO/Sec. This value is the associated port group’s I/O limit divided across its ports.

**Child Host I/O Limit (MB/Sec)**—Total child host I/O limit on the listed port in MB/Sec. This value is the associated port group’s I/O limit divided across its ports.
Child Host I/O Limit (IO/Sec)—Total child host I/O limit on the listed port in IO/Sec. This value is the associated port group’s I/O limit divided across its ports.

Managing mainframes

Before you begin

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

The Mainframe Dashboard provides you with a single place to monitor and manage configured splits, CU images, and CKD volumes. To access the Mainframe Dashboard:

Procedure

1. Select the storage system.
2. Select Hosts > Mainframe Dashboard.

The Mainframe Dashboard is organized into the following panels:

- CKD Compliance
- Common Tasks
- Summary

CKD Compliance panel
Displays how well CKD storage groups are complying with their respective service level policies, if applicable. All of the storage groups on the mainframe are organized into the following categories:

Total
All storage groups on the mainframe.

29

Stable
Number of storage groups performing within the service level targets.

indicates that there are no storage groups performing within the service level targets.

10

Marginal
Number of storage groups performing below service level targets.

indicates that there are no storage groups performing below service level targets.
Critical
Number of storage groups performing well below service level targets.

indicates that there are no storage groups performing well below service level targets.

No Service Level
No service level compliance information.

Common Tasks
Displays the following links:

Provision Storage for Mainframe
Opens the Mainframe Provision wizard, which guides you through the process of provisioning storage for a mainframe. For more information, see Using the Provision Storage wizard for mainframe on page 96.

Create CKD Volumes
Opens the Create Volume dialog, from where you can create a CKD volume. For more information, see Creating CKD volumes (HYPERMAX OS 5977) on page 420.

Summary
Displays the following mainframe summary information:

Splits
The number of splits on the selected mainframe. To view the list of splits, click Splits. For more information about viewing splits, see Viewing splits on page 417.

CU Images
The number of CU images on the selected mainframe. To view the list of CU images, click CU Images. For more information about viewing CU images, see Viewing CU images on page 418.

CKD Volumes
The number of CKD volumes on the selected mainframe. To view the list of CKD volumes, click CKD Volumes. For more information about viewing CKD volumes, see Managing volumes (HYPERMAX OS 5977 or higher) on page 203.

Provisioning VMAX storage for mainframe (HYPERMAX OS 5977 and higher)

With the release of HYPERMAX OS 5977 Q1 2016, Unisphere for VMAX introduces support for service level provisioning for mainframe. Service level provisioning simplifies VMAX management by automating many of the tasks associated with provisioning storage.
Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the service level and capacity required for the application and the system provisions the storage group appropriately.

You can provision CKD storage to a mainframe host using the Provision Storage wizard. For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 96.

The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To provision storage for Open Systems, refer to Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91.

Mapping CKD devices to CU images
You can map CKD devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x000 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map CKD devices to CU images, see the following tasks:
- z/OS map from the CU image list view (HYPERMAX OS 5977 or higher) on page 421
- z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422

Using the Provision Storage wizard for mainframe

Before you begin
- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

To provision storage to mainframe:

Procedure
1. Select the storage system.
2. Select Hosts > Mainframe Dashboard.
3. In the Common Tasks panel, click Provision Storage to Mainframe. The Provision Storage wizard for mainframe is displayed.
4. In the Create Storage Group page, type a Storage Group Name.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.
   If you want to create an empty storage group, proceed to the final step after typing the storage group name.
5. Select a Storage Resource Pool.
   To create the storage group outside of FAST control, select None. External storage resource pools are listed below the External heading.
6. Select an Emulation type. Available values are CKD-3390 and CKD-3380.

7. Select the Service Level to set on the storage group.

Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance level</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

8. Type the number of Volumes and select either a Model or Volume Capacity. Selecting a Model type automatically updates the Volume Capacity value. Alternatively, you can type the Volume Capacity.

- **Note**
  The maximum volume size supported on a VMAX3 system is 64 TB. It is possible to create an empty Storage Group with no volumes.

9. (Optional) Configure volume options:

- **Note**
  When using this option, Unisphere for VMAX uses only new volumes when creating the storage group; it will not use any existing volumes in the group.

  a. Hover the cursor on the service level and click the edit icon.

  b. Edit the Volume Identifier.

  The following options are available:

  - **None**
    Do not set a volume identifier.

  - **Name Only**
    All volumes will have the same name. Type the name in the Name field.

  - **Name and VolumeID**
    All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

  - **Name and Append Number**
    All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the
Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

c. To Allocate capacity for each volume you are adding to the storage group, select this option. You can use the this option only for newly created volumes, not existing volumes.

d. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

e. Click OK.

10. (Optional) To add a child storage group, do one of the following:
   • On all-flash storage systems, click Add Storage Group.
   • On all other storage systems click Add Service Level.

Specify a Name, Service Level, Volumes, and Model/Volume Capacity. Repeat this step for each additional child storage group. The maximum number of child storage groups allowed is 64.

11. To create a storage group, without actually provisioning it, click one of the following; otherwise, click Next and continue with the remaining steps in this procedure:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873
   • Expand Add to Job List, and click Run Now to perform the operation now.

12. On the CU Image page, select whether to use a New or an Existing CU image, and then do the following depending on your selection:
   • New:
     a. Specify the following information for the new CU image:
        ▪ CU Image Number
        ▪ SSID
        ▪ Base Address
     b. Select a Split with which to associate the CU image.
   • Existing:
     a. Select a CU image.
     b. To specify a new value for the base address, click Set Base Address. For more information about setting the base address, refer to Setting the base address on page 427.

13. Click Next.

14. On the Review page, review the summary information displayed.

If the storage system is registered for performance, you can subscribe for compliance alerts for the storage group and run a suitability check to ensure that the load being created is appropriate for the storage system.
To enable compliance alerts, select Enable Compliance Alerts.
To run a suitability check, click **Run Suitability Check**.

15. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Viewing splits

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To view the splits list view:

**Procedure**

1. Select the storage system.
2. Select **Host > Mainframe Dashboard**
3. Click **Splits** to display the **Splits** list view.

The following properties display:

- **Split Name**
  - The user-defined name for the split.
- **Alpha Serial #**
  - The alpha serial number of the split.
- **HyperPAV**
  - Indicates if HyperPAV is enabled on the split.
- **CU Images**
  - The number of CU images associated with the split.
- **Ports**
  - The number of FICON ports assigned to the split.

The following controls are available:

- **View Details** — Viewing split details on page 417

### Viewing split details

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To view the splits detailed view:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. Click **Splits** to display the **Splits** list view.
4. Select the split. Click **View Details**.

The following properties display:

**Split Name**
The user-defined name for the split.

**Alpha Serial #**
The alpha serial number of the split.

**HyperPAV**
Indicates if HyperPAV is enabled on the split.

**Number of CU Images**
The number of CU images associated with the split.

**Number of Ports**
The number of FICON ports assigned to the split.

---

**Viewing CU images**

To view the CU images list view:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. Click **CU Images** to display the **CU Images** list view.

The following properties display:

**CU Image Number**
The CU image number.

**SSID**
The netmask prefix value of the IP interface.

**Split**
The name of the split containing the CU image.

**Number of Volumes**
The number of volumes mapped to the CU image.

**Storage Groups**
The number of storage groups containing volumes mapped to the CU image.

**Total Number of Base Addresses**
The total number of the base addresses configured on the CU image. The total includes used plus unused base addresses.

**Number of Aliases**
The number of aliases in use on the CU image.

**Status**
The status of volumes in the CU image.

The following controls are available:
Viewing CU image details

To view the CU images detailed view:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. Click **CU Images** to display the **CU Images** list view.
4. Select the CU image. Click **View Details**.

The following properties display:

- **CU Image Number**
  The CU image number.

- **SSID**
  The CU SSID.

- **Split**
  The name of the containing split.

- **Number of Volumes**
  The number of volumes.

- **Storage Groups**
  The number of status groups.

- **Status**
  The current status of the CU image.

- **Total Number of Base Addresses**
  The total number of base addresses configured on the CU image. The total includes used plus unused base addresses.

- **Number of Available Base Addresses**
  The number of available base addresses, in hexadecimal.

- **Available Base Addresses**
  The available base address ranges on the CU image.

- **Next Available Base Address**
  The next available base address, in hexadecimal.

- **Number of Aliases**
  The number of alias addresses.
Alias Address Range

The assigned alias address range, if applicable.

The following controls are available:

- **z/OS Map** — z/OS map from the CU image list view (HYPERMAX OS 5977 or higher) on page 421
- **z/OS Unmap** — z/OS unmap from the CU image list view (HYPERMAX OS 5977 or higher) on page 422
- **Assign Alias Range** — Adding an alias range to a CU image on page 425
- **Remove Alias Range** — Removing an alias range from a CU image on page 425

Creating CKD volumes (HYPERMAX OS 5977)

This procedure explains how to create CKD volumes on VMAX systems running HYPERMAX OS 5977.

**Before you begin**

- The storage system must be running HYPERMAX OS 5977.810.784, or later, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

**Procedure**

1. Select the storage system.
2. Do one of the following:
   - Hover the cursor over the **Storage** menu and select **Common Tasks > Create Volumes**.
   - Select **Hosts > Mainframe Dashboard**. In the **Common Tasks** panel, click **Create CKD volume**.
3. Select the **Configuration** type.
4. From the **Emulation** list, select one of the following values:
   - **CKD-3390**
   - **CKD-3380**
5. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**.
   - If the **Model** menu is available, selecting a model automatically updates the volume capacity to the correct capacity. Alternatively, you can manually enter a volume capacity.
6. (Optional) To add the volumes to a CKD storage group, click **Select**, select the CKD storage group, and then click **OK**.
7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Click **Show Advanced** to set the advanced options, as described next. The advanced options that are presented depend on the configuration details. Complete any of the following steps that are appropriate:

a. If required, type an **SSID** or click **Select** to choose one.

b. To name the new volumes, select one of the following **Volume Identifiers**:

   - **None**
     
     Allows the system to name the volumes (Default).

   - **Name Only**
     
     All volumes will have the same name.

   - **Name + VolumeID**
     
     All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50.

   - **Name + Append Number**
     
     All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. **Valid Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

   For more information on naming volumes, refer to Setting volume names on page 226.

c. Depending on the value selected for **Volume Identifier**, type a **Name**, or a **Name and Append Number**.

d. If creating thin volumes or a thin BCVs, you can specify to **Allocate Full Volume Capacity**

   In addition, you can mark the preallocation on the thin volume as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations.

e. Do one of the following:

   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**z/OS map from the CU image list view (HYPERMAX OS 5977 or higher)**

**Before you begin**

The storage system must be running HYPERMAX OS 5977 Q1 2016.

To map to a CU image from the CU image list view:

**Procedure**

1. Select the storage system.

2. Select **Hosts > Mainframe Dashboard**.
3. Click CU Images.

4. Select a CU image, which has not already been mapped, and click z/OS Map.
   The CU Image Map wizard displays.

5. In the Find Volumes page, search for a volume to which you can map the CU image:
   a. (Optional) Specify one or more criteria by which you can filter volumes.
      An Additional Criteria filter for volumes with emulation CKD-3390 is applied by default.
   b. (Optional) Click Add Another to configure further additional criteria.
   c. Click Find Volumes.

6. In the Select Volumes page, select one or more volumes to map to the CU image.

7. Click Summary.

8. Review the summary information.

9. (Optional) To reset the base address, click Set Base Address and specify the new base address.

10. Do one of the following:
    a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
    b. Expand Add to Job List and click Run Now to perform the operation now.

z/OS unmap from the CU image list view (HYPERMAX OS 5977 or higher)

Before you begin
The storage system must be running HYPERMAX OS 5977 Q1 2016.

To unmap a CU image from the CU image list view:

Procedure
1. Select the storage system.
2. Select Hosts > Mainframe Dashboard.
3. Click CU Images.
4. Select the CU image you want to unmap. Click z/OS Unmap.
   The CU Image Unmap dialog box displays.
5. Select one or more volumes to unmap from the CU image.
6. Do one of the following:
   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   b. Expand Add to Job List and click Run Now to perform the operation now.

z/OS map from the volume list view (HYPERMAX OS 5977 or higher)

Before you begin
The storage system must be running HYPERMAX OS 5977 Q1 2016.
To map to a CU image from the volume list view:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. Click **CKD Volumes**.
4. Select one or more volumes to map, click \[>>\], and click **z/OS Map**.

   The **Mainframe Volumes Mapping** dialog box displays.
5. Select whether to want to map the volume(s) to a **New** or an **Existing** CU image.
   - **New**
     a. Specify values for **CU Image Number**, **SSID**, and **Base Address**.
     b. (Optional) Select a **Split**.
   - **Existing**
     a. Select the CU image to which you want to map the selected volume(s).
     b. (Optional) Click **Set Base Address** to reset the next available base address.
6. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**z/OS unmap from the volume list view (HYPERMAX OS 5977 or higher)**

To unmap a CU image (from the volume list view):

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. Click **CKD Volumes**.
4. Select one or more volumes to unmap, click \[>>\], and click **z/OS Unmap**.

   The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.
5. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**z/OS map from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)**

**Before you begin**

The storage system must be running HYPERMAX OS 5977 Q1 2016.
To map to a CU image from the Volumes (Storage Groups) list view:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
4. Select the storage group and click on **View Details**. In the **Related Object** panel, click **Volumes** to open the **Volumes (Storage Groups)** list view.
5. Select one or more volumes to map, click >>>, and click **z/OS Map**.

The **Mainframe Volumes Mapping** dialog box displays.

6. Select whether to want to map the volume(s) to a **New** or an **Existing** CU image.
   - **New**
     a. Specify values for **CU Image Number**, **SSID**, and **Base Address**.
     
     b. (Optional) Select a **Split**.
   - **Existing**
     a. Select the CU image to which you want to map the selected volume(s).
     b. (Optional) Click **Set Base Address** to reset the next available base address.
7. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**z/OS unmap from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)**

To unmap a CU image (from the Volumes (Storage Groups) list view):

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe Dashboard**.
3. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
4. Select the storage group and click on **View Details**. In the **Related Object** panel, click **Volumes** to open the **Volumes (Storage Groups)** list view.
5. Select one or more volumes to unmap, click >>>, and click **z/OS Unmap**.
6. Click **Yes** to the warning dialog box.

The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.

7. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
b. Expand Add to Job List and click Run Now to perform the operation now.

Adding an alias range to a CU image

Before you begin
The storage system must be running HYPERMAX OS 5977 Q1 2016.

To add an alias range to a CU image:

Procedure
1. Select the storage system.
2. Select Hosts > Mainframe Dashboard.
3. Do one of the following:
   a. Launch the Assign Alias Range dialog box from the CU images list view:
      a. Click CU Images.
      b. Select the CU image to which you want to add an alias range.
      c. Click Assign Alias Range.
   b. Launch the Assign Alias Range dialog box from the CU image detailed view:
      a. Click CU Images.
      b. Select the CU image to which you want to add an alias range.
      c. Click View Details.
      d. Click Assign Alias Range.
4. Type the Start Alias.
   The minimum value allowed is 00.
5. Type the End Alias.
   The maximum value allowed is FF.
6. If required, select Reserve Volumes.
7. Do one of the following:
   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   b. Expand Add to Job List and click Run Now to perform the operation now.

Removing an alias range from a CU image

Before you begin
- The storage system must be running HYPERMAX OS 5977 Q1 2016.
- This operation removes all of the aliases for the selected CU image.

To remove an alias range from a CU image:

Procedure
1. Select the storage system.
2. Select Hosts > Mainframe Dashboard.
3. Do one of the following:
Host Management

- Launch the **Remove Alias Range** dialog box from the CU images list view:
  a. Click **CU Images**.
  b. Select the CU image from which you want to remove the alias ranges.
  c. Click **Remove Alias Range**.
- Launch the **Remove Alias Range** dialog box from the CU image detailed view:
  a. Click **CU Images**.
  b. Select the CU image from which you want to remove the alias ranges.
  c. Click **View Details**.
  d. Click **Remove Alias Range**.

4. Review the information displayed in the **Remove Alias Range** dialog box and do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.

### Assigning alias ranges

The following explains how to assign a range of aliases to mapped CKD volumes on a storage system Enginuity 5773 or higher:

**Procedure**

1. Select a storage system.
2. Select **Hosts > Mainframe > CU Images**.
3. Select an image and select **Assign Alias Range**.
4. Type the Start Alias address.
5. Type the End Alias address.
6. Click one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Removing alias counts

The following explains how to remove a range of aliases from mapped CKD volumes on storage systems running Enginuity 5773 or higher:

**Procedure**

1. Select a storage system.
2. Select **Hosts > Mainframe > CU Images**.
3. Select an image and select **Remove Alias Range**.
4. Click one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.
Setting the base address

The Set Base Address dialog box is launched from the following locations:

- Provision Storage wizard — Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91
- CU Image Map wizard — z/OS map from the CU image list view (HYPERMAX OS 5977 or higher) on page 421
- Mainframe Volumes Mapping dialog — z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422

To set the base address:

Procedure

1. In the Base Address field, specify a new value for base address.
   
   Addresses in the range 00-FF are allowed.

2. Click OK.

Understanding VMAX All Flash Mixed FBA/CKD support (HYPERMAX OS 5977 and higher)

With the release of HYPERMAX OS 5977 Q2 2017, Unisphere for VMAX introduces support for VMAX All Flash Mixed FBA/CKD arrays.

Note

This feature is only available for VMAX All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed All Flash system
- Installed at HYPERMAX OS 5977 Q2 2017 or later

You can provision FBA/CKD storage to a mainframe host using the Provision Storage wizard.

For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 96, by default only the CKD SRP is available in the Storage Resource Pool drop down list.

To provision storage for Open Systems, refer to Using the Provision Storage wizard (HYPERMAX OS 5977 or higher) on page 91, by default only the FBA SRP is available in the Storage Resource Pool drop down list.

For specific instructions about how to modify a storage group, refer to Modifying storage groups on page 118, depending on the storage group selection the Storage Resource Pool drop down list is filtered to display the CKD or FBA SRP.
Note

1. A CKD SG can only provision from a CKD SRP
2. A FBA SG can only provision from a FBA SRP
3. FBA volumes cannot reside in a CKD SRP
4. CKD volumes cannot reside in a FBA SRP
5. Compression is only for FBA volumes

Mapping FBA devices to CU images

You can map FBA devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x000 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map FBA devices to CU images, see the following tasks:

- z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 428
- z/OS unmap FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 429

### z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)

**Before you begin**

This feature is only available for VMAX All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed all flash system
- Installed at HYPERMAX OS 5977 Q2 2017 or later

See Understanding VMAX All Flash Mixed FBA/CKD support (HYPERMAX OS 5977 and higher) on page 427 for additional information.

To map to a CU image from the Volumes (Storage Groups) list view:

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups Dashboard to open the Storage Groups Dashboard.
3. In the Storage Groups panel, click Total to open the Storage Groups list view.
4. Select the storage group. In the Related Object panel, click Volumes to open the Volumes (Storage Groups) list view.
5. Select one or more volumes to map, click \[>>\], and click z/OS Map.
   The Mainframe Volumes Mapping dialog box displays.
6. Select whether to want to map the volume(s) to a New or an Existing CU image.
• New
  a. Specify values for **CU Image Number**, **SSID**, and **Base Address**.
  b. (Optional) Select a **Split**.

• Existing
  a. Select the CU image to which you want to map the selected volume(s).
  b. (Optional) Click **Set Base Address** to reset the next available base address.

7. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**z/OS unmap FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)**

**Before you begin**

This feature is only available for VMAX All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed all flash system
- Installed at HYPERMAX OS 5977 Q2 2017 or later

See [Understanding VMAX All Flash Mixed FBA/CKD support (HYPERMAX OS 5977 and higher)](#) on page 427 for additional information.

To unmap a CU image (from the Volumes (Storage Groups) list view):

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups Dashboard** to open the **Storage Groups Dashboard**.
3. In the **Storage Groups** panel, click **Total** to open the **Storage Groups** list view.
4. Select the storage group. In the **Related Object** panel, click **Volumes** to open the **Volumes (Storage Groups)** list view.
5. Select one or more volumes to unmap, click ➤➤, and click **z/OS Unmap**.

The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.
6. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.
   b. Expand **Add to Job List** and click **Run Now** to perform the operation now.
Removing storage from a VM

Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.

This procedure explains how to remove storage from a virtual server.

To add a new virtual server:

Procedure

1. Select the storage system or All Symmetrix systems.
2. Select Hosts > Virtual Servers to open the Virtual Servers list view.
3. Select the virtual server and click View Details to open the Details view.
4. Click Volumes - nn in the Related Objects panel to open the Volumes list view.
5. Select one or more volumes and click Remove VM Storage.
6. Click OK.

Adding a new virtual server

Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.
- For more information on integrating in a virtual environment, refer to the Techbook, Using Symmetrix Storage in VMware vSphere Environments.

This procedure explains how to register a virtual server (VMware or Hyper V). You must complete this procedure before you can add the virtual server's storage to the VM.

To add a new virtual server:

Procedure

1. Select the storage system or All Symmetrix systems.
2. Select Hosts > Virtual Servers.
3. Click Add VM Server.
4. Type the fully qualified name or IP address of the server (Server/IP Address).
5. Type the Username used to connect to the server. The user must have root privileges on the server.
6. Type the Password used to connect to the server.
7. Retype the password for confirmation.
8. Select the type of server to add (VMware or Hyper-V).
9. Optional: Select Retrieve Info to have Unisphere for VMAX retrieve all the information on the server. If Unisphere returns an error message when retrieving information on an ESX server, verify that the ESX server's domain name matches the name in the credential file.
10. Click OK.
Adding storage to a VM

Before you begin
- To perform this operation, you must be an Administrator or StorageAdmin.

This procedure explains how to add a virtual server's storage to a VM.

To add a new virtual server:

Procedure
1. Select the storage system or All Symmetrix systems.
2. Select Hosts > Virtual Servers to open the Virtual Servers list view.
3. Select the virtual server and click View Details to open its Details view.
4. Click Volumes - nn in the Related Objects panel to open the Volumes list view.
5. Select one or more volumes and click Add VM Storage to open the Add VM Storage dialog box.
6. Select the VM to which you are adding the volumes.
7. Click OK.

Removing a virtual server

Before you begin
- To perform this operation, you must be an Administrator or StorageAdmin.

This procedure explains how to remove a virtual server.

To add a new virtual server:

Procedure
1. Select the storage system or All Symmetrix systems.
2. Select Hosts > Virtual Servers to open the Virtual Servers list view.
3. Select the virtual server and click Remove.
4. Click OK.

Note
A virtual server can also be removed from the virtual server Details view.

Changing the password on a virtual server

Before you begin
- To perform this operation, you must be an Administrator or StorageAdmin.

This procedure explains how to change the password used to access a virtual server.

To add a new virtual server:

Procedure
1. Select the storage system or All Symmetrix systems.
2. Select Hosts > Virtual Servers to open the Virtual Servers list view.
3. Select the virtual server and click Change Password.
4. Click **OK** on the confirmation message to open the **Change Virtual Server Password** dialog box.

5. Type a new **Password** and repeat it for confirmation.

6. Click **OK**.

---

**Note**

The virtual server password can also be changed from the virtual server **Details** view.

---

### Viewing virtual servers

**Procedure**

1. Select the storage system or **All Symmetrix** systems.

2. Select **Hosts > Virtual Servers**.

   The following properties display:

   - **Server/IP Address** — The fully-qualified server name or IP Address.
   - **Server Type** — The virtual server type. Possible values are VMware and Hyper-V.
   - **VMs** — The number of VMs.
   - **Volumes** — The number of volumes.
   - **Last Updated** — The timestamp of the refresh for the virtual server. If the server does not have a timestamp, click **View Details** to rescan the server.

   The following controls are available:

   - **Add** — **Adding a new virtual server** on page 430
   - **View Details** — **Viewing the details of a virtual server** on page 432
   - **Change Password** — **Changing the password on a virtual server** on page 431
   - **Remove** — **Removing a virtual server** on page 431

### Viewing the details of a virtual server

**Procedure**

1. Select the storage system or All Symmetrix systems.

2. Select **Hosts > Virtual Servers**.

3. Select the virtual server and click **View Details**.

   This view contains two panels, **Properties** and **Related Objects**.

   **Properties** panel

   The following properties display:

   - **Server/IP Address** — The fully-qualified server name or IP Address.
   - **Server Type** — The virtual server type. Possible values are VMware and Hyper-V.
   - **Total Memory** — Total memory of the virtual server.
   - **Build** — The virtual server's build number.
   - **Version** — The virtual server's version number.
- **Last Updated**—The timestamp of the last refresh of the virtual server.

The following controls are available:

- **Change Password**—[Changing the password on a virtual server](#) on page 431
- **Remove**—[Removing a virtual server](#) on page 431

**Related Objects panel**

The **Related Objects** panel provides links to views for the objects contained in or associated with the virtual server. Each link provides the name of the related object and the number of items. For example, clicking **Volumes - 34** opens the **Volumes** list view showing the 34 volumes related to the virtual server.

### Viewing virtual server volumes

**Procedure**

1. Select the storage system or **All Symmetrix** systems.
2. Select **Hosts > Virtual Servers**.
3. Select the virtual server and click **View Details**.
4. Click **Volumes** in the **Related Objects** panel to open the **VMs** list view.

   The following properties display:
   
   - **Device ID**—The volume ID.
   - **VM Name**—The VM name.
   - **Device Name**—The volume name.
   - **Vendor**—The device vendor.
   - **Array ID**—The Symmetrix ID of the volume.
   - **Product Name**—The product or system name. For example, Symmetrix.
   - **Datastore Name**—The datastore name.
   - **Device Capacity (GB)**—The volume capacity.

   The following controls are available:
   
   - **Add VM Storage**—[Adding storage to a VM](#) on page 431
   - **Remove VM Storage**—[Removing storage from a VM](#) on page 430

### Viewing VM details

**Procedure**

1. Select the storage system or **All Symmetrix** systems.
2. Select **Hosts > Virtual Servers**.
3. Select the virtual server and click **View Details**.
4. Click **VMs - nn** in the **Related Objects** panel to open the **VMs** list view.
5. Select the virtual server and click **View Details** to open its Details view.

   This view contains two panels, **Properties** and **Related Objects**.

   **Properties panel**

   The following properties display:
   
   - **VM Name**—The VM name.
• **VM OS Name**—The VM operating system.
• **VM State**—The VM state.
• **Number of CPUs**—The number of CPUs in the VM.
• **Total Memory**—Total memory of the VM.

**Related Objects panel**
The **Related Objects** panel provides links to views for the objects contained in or associated with the VM. Each link provides the name of the related object and the number of items. For example, clicking **Volumes - 34** opens the **Volumes** list view showing the 34 volumes related to the VM.

**Viewing VMs**

**Procedure**
1. Select the storage system or **All Symmetrix systems**.
2. Select **Hosts > Virtual Servers**.
3. Select the virtual server and click **View Details**.
4. Click **VMs - nn** in the **Related Objects** panel to open the **VMs** list view.
   The following properties display:
   • **VM Name**—The VM name.
   • **VM OS Name**—The VM operating system.
   • **VM State**—The VM state.
   • **Number of CPUs**—The number of CPUs in the VM.
   • **Total Memory**—Total memory of the VM.
   The following control displays:
   • **View Details**—**Viewing VM volume details** on page 434

**Viewing VM volume details**

**Procedure**
1. Select the storage system or **All Symmetrix systems**.
2. Select **Hosts > Virtual Servers**.
3. Select the virtual server and click **View Details**.
4. Click **VMs - nn** in the **Related Objects** panel to open the **VMs** list view.
5. Select the **VM** and click **View Details**.
6. Select **Volumes - nn** from the **Related Objects** panel to open the **Volumes** list view.
   The following properties display:
   • **Device ID**—The volume ID.
   • **Vendor**—The volume vendor.
   • **Array ID**—The Symmetrix ID of the volume.
   • **Product Name**—The product or system name. For example, Symmetrix.
• **Datastore Name**—The datastore name.

• **Device Capacity (GB)**—The volume capacity.

The following controls are available:

• **Add VM Storage**—Adding storage to a VM on page 431

• **Remove VM Storage**—Removing storage from a VM on page 430

### Viewing VM volumes

**Procedure**

1. Select the storage system or All Symmetrix systems.
2. Select **Hosts > Virtual Servers**.
3. Select the virtual server and click **View Details**.
4. Click **VMs - nn** in the Related Objects panel to open the VMs list view.

This view contains two panels, **Properties** and **Related Objects**.

**Properties panel**

The following properties display:

• **VM Name**—The VM name.

• **VM OS Name**—The VM operating system.

• **VM State**—The VM state.

• **Number of CPUs**—The number of CPUs in the VM.

• **Total Memory**—Total memory of the VM.

**Related Objects panel**

The Related Objects panel provides links to views for the objects contained in or associated with the VM. Each link provides the name of the related object and the number of items. For example, clicking **Volumes - 34** opens the Volumes list view showing the 34 volumes related to the VM.

### Mapping CKD volumes

The following explains how to map CKD volumes to ESCON/FICON ports.

You can perform this operation at the volume level or the CU image level.

**Procedure**

1. Select the storage system.
2. To map at the volume level:
   a. Select **Storage > Volumes**.
   b. In the **Volumes** panel, select the type of **CKD volume**.
      To display only CKD volumes in the Volumes panel, set the Emulation filter to CKD.
   c. Click **View** to open the CKD Volumes list view.
   d. Select a CKD volume, and click **z/OS Map** to open the **z/OS Map Volumes** dialog box.
To map at the CU image level:

- Select Hosts > CU Images.
- Select an image and click z/OS Map to open the z/OS Map dialog box.

3. Type or Select a Volume Range.
4. Type the Base Address to be assigned to the first volume in the mapping request.

   Base addresses increase incrementally by one for each volume in the range of volumes being mapped. To view base addresses already in use, click Show.

5. Type or Select an SSID.

   Valid SSIDs must only have unmapped volumes using them and the number of volumes cannot exceed 256.

6. Select the Port to which you want to map the volumes.
7. Click one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Unmapping CKD volumes

The following explains how to unmapped CKD volumes from ESCON/FICON ports.

You can perform this operation at the volume level or the CU image level.

Procedure

1. Select the storage system.
2. To unmap at the volume level:
   - Select Storage > Volumes to open the Volume Dashboard.
   - In the Volumes panel, select the type of CKD volume.
   - To display only CKD volumes in the Volumes panel, set the Emulation filter to CKD.
   - Click View to open the CKD Volumes list view.
   - Select a CKD volume, and click z/OS Unmap to open the z/OS Unmap Volumes dialog box.
3. To unmap at the CU image level:
   - Select Hosts > CU Images to open the CU Images list view.
   - Select an image and click z/OS Unmap to open the Unmap CU Image dialog box.
4. Type or Select the Volume Range to be unmapped.
5. Type or Select the Base Address.
6. Type or Select an SSID.

   Valid SSIDs must only have unmapped volumes using them, and the number of volumes cannot exceed 256.
7. Select the Port to which you want to map the volumes.
7. Click one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Copying CU image mapping

**Before you begin**

Before you begin:

All volumes in a specified range must be mapped to the same CU image, or not mapped at all. Volumes within the specified range that are not mapped will be ignored as long as they are not mappable (SAVE devices, DRVs, and so on). If a volume in the specified range is mappable, the request will be rejected.

The following explains how to copy the front-end mapping addresses of a set of volumes from one port to another, providing multi-path access from the storage system to the mainframe.

To copy CU image mapping:

**Procedure**

1. Select **Hosts > CU Images** to open the **CU Images** list view.
2. Select an image, and click **Copy Mapping** to open the **z/OS Map** dialog box.

### Assigning alias counts

Assigning alias counts

The following explains how to add a number of aliases to mapped CKD volumes on storage systems running Enginuity 5773 or higher:

**Procedure**

1. Select a storage system.
2. Select **Hosts > CU Images**.
3. Select an image, click more , and select **Add Alias Count** to open the **Add Alias Count** dialog box
4. Type or **Select** the **Volume Range** to which the aliases will be added.
5. Type the number of aliases to add to each volume in the range (**Alias Count**).
6. Click one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Removing alias counts

The following explains how to remove a number of aliases from mapped CKD volumes on storage systems running Enginuity 5773 or higher:
**Procedure**

1. Select a storage system.
2. Select Hosts > CU Images.
3. Select an image, click more ▶, and select Remove Alias Count to open the Remove Alias Count dialog box.
4. Type or Select the Volume Range from which to remove the aliases.
5. Type the number of aliases to remove from each volume in the range (Alias Count).
6. Click one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**Viewing CU images**

Viewing CU images

**Procedure**

1. Select the storage system.
2. Select Hosts > CU Images to open the CU Images list view.
3. Use the CU Images list view to view and manage CU images.

**Results**

The following properties display:

- **Image SSID** — CU image number 0x0-0xFF.
- **SSID** — SSID (subsystem ID) for the image.
- **Number of Ports** — The number of ports to which the CU image is mapped.
- **Number of Volumes** — The number of volumes in the CU.
- **Number of Base Addresses** — The number of base addresses assigned.
- **Number of Aliases** — The number of aliases assigned.
- **Status** — The status of volumes in the CU image.

The following controls are available:

- **z/OS Map**—z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422
- **z/OS Unmap**—z/OS unmap from the volume list view (HYPERMAX OS 5977 or higher) on page 423

**Viewing CU image details**

**Viewing CU image details**

Viewing CU image details
Procedure

1. Select the storage system.
2. Select Hosts > CU Images.
3. Select the CU image, and click View Details to open its Details view.
4. Use the CU image Details view to display and manage a CU image.

This view contains two panels, Properties and Related Objects.

- **Properties** panel

  The following properties display:
  - **Image SSID** — CU image number 0x0-0xFF.
  - **SSID** — SSID (subsystem ID) for the image.
  - **Number of Ports** — The number of ports to which the CU image is mapped.
  - **Number of Volumes** — The number of volumes in the CU.
  - **Number of Base Addresses** — Number of base addresses assigned.
  - **Number of Aliases** — The number of aliases assigned.
  - **Status** — The status of volumes in the CU image.

  The following controls are available:
  - **z/OS Map** — z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422
  - **z/OS Unmap** — z/OS unmap from the volume list view (HYPERMAX OS 5977 or higher) on page 423
  - **Assign Alias Count** — Assigning alias counts on page 437
  - **Remove Alias Count** — Removing alias counts on page 437

- **Related Objects** panel

  The Related Objects panel provides links to views for objects contained in and associated with the CU image. Each link is followed by a number, indicating the number of objects in the corresponding view.

  For example, clicking Volumes - 2 opens a view listing the two volumes in the image.

### Viewing CKD volume front end paths

This procedure explains how to view CKD volume front end paths.

**Procedure**

1. Select the storage system.
2. Select Hosts > CU Images to open the CU Images list view.
3. Select the CU image and click View Details to open its Details view.
4. In the Related Objects panel, click Volumes to open the CKD Volumes list view.
5. Select a CKD volume and click View Details to open its Details view.
6. In the Related Objects panel, click CKD Front End Paths to open the CKS Front End Path list view.
7. The following properties display:
8. **Director Identifier**—Director name.
9. **Port**—Port number.
10. **Base Address**—Assigned base address.
11. **Alias Count**—Number of aliases mapped to the port.
12. **Director Port Status**—Indicates port status.

**Available Volume for EA/EF Mapping dialog box**

Use this dialog box to select one or more volumes for the mapping operation. To select a range of volumes, select the first volume in the range, press and hold the `Shift` key, and then click the last volume in the range.

**Base Addresses in Use dialog box**

Use this dialog box to view base addresses already in use.

**Select SSID dialog box**

Use this dialog box to select an SSID for the operation.

**Viewing CKD volumes in CU image**

**Procedure**

1. Select the storage system.
2. Select **Hosts > CU Images**.
3. Select the **CU image** and click **View Details**.
4. In the **Related Objects** panel, click **Volumes** to open the **CKD Volumes** list view.
5. Use the **CKD Volumes** list view to display and manage CKD volumes in a CU image.

**Results**

**Name** — Symmetrix volume name.
**Type** — Volume configuration.
**Status** — Volume status.
**Capacity (GB)** — Volume capacity in GBs.
**Emulation** — Emulation type.
**UCB Address** — Unit control block (address used by z/OS to access this volume).
**Volser** — Volume serial number (disk label (VOL1) used when the volume was initialized).

The following controls are available:

- **View Details**—Viewing CU image details on page 419
- **z/OS Map**—z/OS map from the volume list view (HYPERMAX OS 5977 or higher) on page 422
- **z/OS Unmap**—z/OS unmap from the volume list view (HYPERMAX OS 5977 or higher) on page 423
Creating host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Click Create.
4. Type a Host Alias Name (up to 64 alphanumeric characters, including underscore and hyphen characters, are allowed).
5. Select one or more Initiators and click OK.

Adding initiators to host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select the host alias and click View Details.
4. In the Related Objects panel, click Initiators.
5. Click OK.

Removing initiators from host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select the host alias and click View Details.
4. In the Related Objects panel, click Initiators.
5. Select one or more initiators and click Remove.
6. Click OK.

Unmasking volumes from host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select the host alias and click View Details.
4. In the Related Objects panel, click Volumes.
5. Select one or more volumes and click Unmask.
6. To automatically unmap the volumes from all ports, select Unmap Volumes.
7. To refresh all the host-related profile data in the volume masking database (VCMDB), select Refresh VCMDB.
8. Click OK.
Deleting host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select one or more aliases and click Delete.
4. Click OK.

Renaming host aliases

When a storage system discovers the attached HBAs, a two-part record is created of the name. The format is HostName/HBAname. For fiber adapters, the HBA name is the WWN or iSCSI name. For native iSCSI adapters, the HBA name is the IP address.

You can rename the HBA identifier by creating a shorter, and easier to remember alias name.

To rename the host alias:

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select an alias and click Rename Alias.
4. Type the two-part Initiator Alias (HostName/NewAdapterAlias).
   For example: api172/20000000920dc290 to api172/p2.
5. Click Add.
6. Select one or more initiators and click OK.
   This operation will overwrite any existing alias name.

Viewing host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases to open the Host Aliases list view.
3. Use the Host Aliases list view to display and manage host aliases.
   The following properties display:
   Host Alias Name—The name of the host alias.
   Number of Initiators—The number of masking records in the host alias.
   Number of Volumes—The number of volumes masked to the initiators.
   The following controls are available:
   Mask—Masking volumes on page 398
   Create—Creating host aliases on page 441
   Set Flags—Setting initiator port flags on page 400
   View Details—Viewing host alias details on page 387
Delete Host Alias—Deleting host aliases on page 442

Viewing host alias details

Procedure
1. Select the storage system.
2. Select the host alias, and click View Details to open its Details view.
3. Use the host alias Details view to display and manage a host alias.
   - This view contains two panels, Properties and Related Objects.
   - The following properties display in the Properties panel:
     - Host Alias Name — the name of the host alias.
     - Number of Initiators — The number of masking records in the host alias.
     - Number of Volumes — The number of volumes masked to the initiators.
   - The following controls are available in the Properties panel:
     - Mask —
     - Set Flags —
     - Delete Host Alias —
   - The Related Objects panel provides links to views for objects contained in and associated with the host alias. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Initiators - 2 opens a view listing the two initiators in the host alias.

Viewing volumes masked to host aliases

Procedure
1. Select the storage system.
2. Select Hosts > Host Aliases.
3. Select the host alias and click View Details.
4. Use the host alias Volumes list view to display and manage the volumes masked to the host alias.
   - The following properties display:
     - Name—Assigned volume name.
     - Type—Type of volume.
     - Capacity (GB) — Volume capacity in Gigabytes.
     - Emulation—Emulation type for the volume.
   - The following control is available:
     - Unmask—Masking volumes on page 398

Viewing host cache adapters

Procedure
1. Select the storage system.
2. Select **Hosts > XtremSW Cache Adapters** to open the **XtremSW Cache Adapters** list view.

   The following properties display:

   - **Card S/N**—Adapter serial number.
   - **Card Version**—Adapter version.
   - **Vender**—Adapter vender.
   - **Card Size (GB)**—Adapter size.
   - **Card Used (GB)**—Amount of card used.
   - **Volumes**—Number of accessible volumes.
   - **Host**—Host name.
   - **IP Address**—Host IP address.
   - **Host OS**—Host operating system.
CHAPTER 6

Data Protection

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Monitoring protection

The Protection Dashboard provides you with a single place from which to monitor the replication features running on or associated with local storage systems. The Protection Dashboard provides you with a single place from which to monitor the replication features running on or associated with local storage systems.

Before you begin:

- To access this dashboard, you must be a Monitor, StorageAdmin or higher.
- This dashboard is only available for storage systems running HYPERMAX OS 5977 or higher.
- The information displayed in this dashboard is static, in that it reflects the system's status at the moment you opened the dashboard. To refresh the data, click refresh in the status bar.

To access the Protection Dashboard:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Protection Dashboard**.

The Protection Dashboard contains the following panels:

**Summary panel:**
- **Remote Arrays** — Number of SRDF-connected storage systems.
- **Technologies** — Lists the replication technologies employed on the storage system.
- **Replication Utilization** — Used percentage of the cache that is available for SnapVX and VP Snap snapshots. The value shown in the bar represents the percentage value of cache used.

**Storage Group Protection panel:**
Displays high-level information obtained from protected and unprotected storage groups on the storage system. All of the storage groups on the storage system are organized into the following categories:

**Note**

Partially protected storage groups do not appear on the dashboard. For example, after adding a volume to a storage group protected by ProtectPoint, the storage group is considered partially protected, in which case it no longer appears in the dashboard. The storage group remains in this state until you expand it using ProtectPoint, after which it is considered fully protected, and reappears on the dashboard.

- **Total** — Total number of storage groups on the storage system, regardless of protection. For more information, refer to Viewing total storage groups on page 153.
- **High Availability** — Number of SRDF/Metro storage groups protected by SRDF/Metro. Both R1 and R2 are included in the totals.
- **Remote Replication**—Number of storage groups protected by SRDF. Storage groups involved in multiple SRDF sessions are only counted once. Only R1s or R2s that are an R1 of an R21 setup are displayed. For more information, refer to Viewing remote replication storage groups on page 151.

- **Point in Time**—Number of storage groups protected by TimeFinder. Depending on the storage operating environment, this can include TimeFinder/SnapVX, TimeFinder/Clone, or TimeFinder/Mirror snapshots. Storage groups involved in multiple Timefinder sessions are only counted once. Also, ProtectPoint storage groups with SnapVX snapshots as a source are also included. For more information, refer to Viewing point-in-time storage groups on page 149.

- **Backup**—Number of storage groups with SnapVX snapshots linked to ProtectPoint storage groups. For more information, refer to Viewing backup storage groups (HYPERMAX OS 5977 or higher) on page 148.

- **Unprotected**—Number of storage groups not covered by Continuous, Point in Time or High Availability. For more information, refer to Viewing unprotected storage groups on page 153.

**Application Protection** panel:

The Application Protection panel allows you to view and manage storage groups that serve as sources in replications sessions.

The following properties display:

- **State**—Replication state severity of the storage group. The value is calculated at the volume level, with the highest (worst) severity being reported for the group. Possible values are:
  - **Normal**—All volumes are in a normal state.
  - **Warning**—One or more volumes in the group are in a warning state, with none higher.
  - **Error**—One or more volumes in the group are in an Error state.

Replication state severities map states of the various replication technologies to severities.

- **Storage Group**—Storage group name.

- **Replication Management Group**—Replication management group associated with the storage group. For example, SRDF Group xx (Remote SymmetrixID) for SRDF, the device group name for Clone, or Mirror, and snapshot name for Snap/VX.

- **Technology** — Replication technology used to protect the storage group.

The following controls available, depending on the replication technology protecting the selected storage group:

- **Create Snapshot**—Creating Snapshots on page 493
- **Link**—Linking to snapshots on page 479
- **Restore**—Restoring snapshots on page 482
- **Unlink**—Unlinking from snapshots on page 481
- **Establish**—Establishing SRDF pairs on page 536
- **Split**—Splitting SRDF pairs on page 550
- **Suspend**—Suspending SRDF pairs on page 551
- **Restore**—Restoring SRDF pairs on page 547
Resume—Resuming SRDF links on page 543
Failover—Failing over on page 537
Failback—Failing back on page 538
Manage Protection—Select a Storage Group and click Manage Protection to display a link dialog box with links to the various replication technologies applied to a storage group—TimeFinder SnapVX, TimeFinder Clone, TimeFinder Mirror, SRDF storage groups, SRDF device groups, and SRDF/Metro groups.
Note that if a storage group has SRDF Protection with a device group and a storage group, then two management options for SRDF are displayed.

Replication state severities

The following are the replication state severities, organized by replication technology:

<table>
<thead>
<tr>
<th>Severity</th>
<th>SRDF State</th>
<th>TimeFinder State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Synchronized</td>
<td>Copied</td>
</tr>
<tr>
<td></td>
<td>SynclnProg</td>
<td>Created</td>
</tr>
<tr>
<td></td>
<td>Split</td>
<td>Restored</td>
</tr>
<tr>
<td></td>
<td>Failed Over</td>
<td>TerminatelnProgress</td>
</tr>
<tr>
<td></td>
<td>R1 UpdlnProg</td>
<td>Recreated</td>
</tr>
<tr>
<td></td>
<td>R1 Update</td>
<td>CopylnProgress</td>
</tr>
<tr>
<td></td>
<td>Consistent</td>
<td>CopyOnAccess</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CreateInProgress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CopyOnWrite</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RestorelnProgress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PreCopy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Split</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SyncInProgress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SplitlnProgress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SplitNoIncremental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EstablishlnProg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linked</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LinkCopied</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NeverEstablished</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Synchronized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SplitBeforeSync</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SplitBeforeRestore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Established</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LinkCopylnProg</td>
</tr>
<tr>
<td>Warning</td>
<td>Suspended</td>
<td>Warning</td>
</tr>
</tbody>
</table>
### Understanding TimeFinder/Clone operations

Clone copy sessions allow you to create clone copies of a source volume on multiple target volumes. The source and target volumes can be either standard volumes or BCVs, as long as they are the same size and emulation type (FBA/CKD). Once you have activated the session, the target host can instantly access the copy, even before the data is fully copied to the target volume.

**Note**

TimeFinder operations are not supported directly on storage systems running HYPERMAX OS 5977 or higher. Instead, they are mapped to their TimeFinder/SnapVX equivalents.

An overview of a typical clone session is:
1. Create a device group, or add volumes to an existing device group.
2. Create the session; restore the session.
3. Activate the session.
4. View the session's progress.
5. Terminate the session.

For more information on TimeFinder/Clone concepts, refer to the *Solutions Enabler TimeFinder Family CLI Product Guide* and the *TimeFinder Family Product Guide*.

### Managing TimeFinder/Clone sessions

**Before you begin**

TimeFinder/Clone requires Enginuity version 5773 or 5876, or HYPERMAX OS 5977 or higher. On HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents using Clone emulation.

The TimeFinder/Clone dashboard provides you with a single place to monitor and manage TimeFinder/Clone sessions on a storage system.

Managing TimeFinder/Clone sessions:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Clone** to open the **TimeFinder/Clone** dashboard.

The following properties display:
- **Device Group** Lists the groups containing volumes using TimeFinder/Clone. Information in this column is organized in a tree format, with groups organized into folders according to their type. To view information on a specific group, expand the appropriate folder.
- **Standard** — The number of standard volumes in the group.
- **BCV** — The number of BCVs in the group.
- **Target** — The number of target volumes in the group.
- **State** — The combined state of the sessions in the group. If all the sessions are in the same state, then that state appears; otherwise, Mixed appears.
- **Group Type** — The type of group. Property values: RDF1, RDF2, RDF21, and Regular.
- **Group Valid** — Indicates whether the group is valid. Property values: Yes or No.

The following controls are available:

- **Create Pairs**—Creating clone copy sessions on page 450
- **Activate**—Activating clone copy sessions on page 452
- **Recreate**—Recreating clone copy sessions on page 453
- **View Storage Groups**—Viewing storage groups (Enginuity 5876) on page 145
- **View Details**—Viewing clone copy sessions on page 459
- **Split**—Splitting clone volume pairs on page 458
- **Restore**—Restoring data from target volumes on page 456
- **Create Snapshot**—Creating Snapshots on page 493
- **Terminate**—Terminating clone copy sessions on page 458
- **Set Mode**—Modifying clone copy sessions on page 455

### Creating clone copy sessions

This procedure explains how to create clone copy sessions.
Note

Note the following:

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.

- You can only perform this operation on a group containing source and target volumes.

- You can use the target volume of a clone session as the source volume for other clone sessions. To use this feature, you must first enable the SYMAPI_ALLOW_DEV_IN_MULT_GRPS option in the SYMAPI options file. For more information on enabling SYMAPI options, refer to the Solutions Enabler CLI Command Reference.

- Data Domain volumes are not supported.

- The clone copy does not become available to the host until the session is activated.

Procedure

1. Select the storage system.

2. Select Data Protection > TimeFinder > TimeFinder/Clone.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   Group level:
   a. Select a group and click Create Pairs to open the Create Pairs - Clone Pair dialog box.

   Pair level:
   a. Select a group and click View Details to open its Details view.
   b. Select one or more pairs and click Create Pairs to open the Create Pairs dialog box.
   c. Click Set Pairs to open the Set TimeFinder Clone Pairs dialog box.
   d. Select a source volume and a target volume and click Add to make them a pair. Repeat this step as required.
   e. Click OK to return to the Create Pairs - Clone Pair dialog box.

4. (Optional) Select Use TGT Volumes to use volumes from a local target list as targets.

5. (Optional) If you selected Use TGT Volumes, you can also select Use BCV Volumes as the source.

6. Do one of the following:

   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to set the advanced options as described next.

Setting Advanced Options:
If performing this operation at the group level, you can optionally select a **Pairing Type** by expanding the menu and selecting one of the following. If you are not using the **Pairing Type** option, leave this field set to **None**.

- **Use Exact Pairs**—Allows the system to pair up the volumes in the exact order that they were added to the group.
- **Use Optimized Pairs**—Optimizes volume pairings across the local Symmetrix system without regard for whether the volumes belong to different RDF (RA) groups.

To select a **Copy Mode**, expand the menu, and select one of the following:

- **Use Background Copy**—Specifies to start copying tracks in the background at the same time as target I/Os are occurring.
- **Use VP SNAP**—Specifies to create the session with TimeFinder VP Snap, which allows multiple sessions to share allocations within a thin pool, thus reducing the storage required for saved tracks.
- **Use No Copy**—Specifies to change the session to CopyOnAccess once the session is activated and no full-volume copy will initiate.
- **Use Pre-Copy**—Specifies to start copying tracks in the background before you activate the clone session.

By default, when creating a clone session, the system will create an SDDF session for maintaining changed track information. To change this default behavior, expand the **Differential Mode** menu, and select **Use No Differential**. Otherwise, leave this field set to **Use Differential**.

To attach **Session Options** to the operation, expand the menu, and select any number of options.

Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Activating clone copy sessions**

This procedure explains how to activate the copy operation from the source volume to the target volume. Activating a copy session places the target volume in the Read/Write state. The target host can access the cloned data and has access to data on the source host until you terminate the copy session.

---

**Note**

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You can only activate clone sessions that are in the Created or Recreated state.
- This procedure explains how to perform this operation from the TimeFinder/Clone dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

To activate the copy operation from the source volume to the target volume:
Procedure

1. Select the storage system.

2. Select Data Protection > TimeFinder > TimeFinder/Clone to open the TimeFinder/Clone dashboard.

3. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
   
   **Group level:**
   - Select a group and click Activate to open the Activate - Device Group dialog box.

   **Pair level:**
   a. Select a group and click View Details to open its Details view.
   b. Select one or more pairs, and click Activate to open the Activate Clone Pair dialog box.

4. Optional: To attach Session Options to the operation, click Show Advanced and select any number of options.

5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Recreating clone copy sessions

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The copy session must not have been created with the No Copy or No Differential option.
- The session must have been activated to establish the new point-in-time copy.
- With Enginuity 5876.159.102 or higher, you can recreate a clone copy without terminating TimeFinder/Snap or VP Snap sessions that are cascading off of the clone target.

This procedure explains how to incrementally copy all subsequent changes made to the source volume (made after the point-in-time copy initiated) to the target volume. While in the Recreated state, the target volume remains Not Ready to the host.

**Procedure**

1. To recreate clone copy sessions:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Clone to open the TimeFinder/Clone dashboard.
   3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      
      **Group level:**
Select a group and click **Recreate** to open the **Recreate - Device Group** dialog.

**Pair level:**

a. Select a group, and click **View Details** to open its **Details** view.
b. Select one or more pairs and click **Recreate** to open the **Recreate - Clone Pair** dialog.

4. Optional: To attach **Session Options** to the operation, click **Show Advanced**, and select any number of options.

5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Creating clone snapshots**

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The create operation sets the target volume to Not Ready for a short time. If you are using a file system, unmount the target host before performing the create operation.

This procedure explains how to create and immediately activate clone snapshots

**Procedure**

1. To create clone snapshots:
   1. Select the storage system.
   2. Select **Data Protection > TimeFinder > TimeFinder/Clone** to open the **TimeFinder/Clone** dashboard.
   3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

      **Group level:**

      a. Select a group, click more , and select **Create Snapshot** to open the **Create Snapshot - Device Group** dialog.

      **Pair level:**

      a. Select a group and click **View Details** to open its **Details** view.

      b. Select one or more pairs, click more , and select **Create Snapshot** to open the **Create Snapshot - Clone Pair** dialog.

4. Specify whether to perform an **Incremental** or **Full** create.

5. If performing this operation at the pair level and performing a **Full** create, do the following:

   a. Click **Set Pairs** to open the **Set Pairs** dialog.

   b. Select a source volume and a target volume and click **Add** to make them a pair. Repeat this step as required.
c. Click OK to close the dialog.

6. Select the **Source Type**.

7. Select the **Target Type**.

8. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Setting Advanced options:

a. To specify **Full Snapshot Options**, expand the menu, and do the following:

- Select one of the following options. If you are not using the **Full Snapshot Options**, leave this field set to **None**.
- **Use Exact Pairs** — Allows the system to pair up the volumes in the exact order that they were added to the group.
- **Use Optimized Pairs** — Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.

b. To create the session with TimeFinder VP Snap, select **Use VP Snap**. Using this option allows multiple sessions to share allocations within a thin pool, thus reducing the storage required for saved tracks.

c. To attach **Session Options** to the operation, expand the menu, and select any number of .

d. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 873 and [Previewing jobs](#) on page 873.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Modifying clone copy sessions

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You can modify the mode between Copy, NoCopy, and Precopy on clone pairs that are in a Created, Recreated, or Activated state.
- Do not change a session created with the Differential option to the No Copy mode, as the session will fail.

This procedure explains how to modify the mode in which a clone copy session is operating.

**Procedure**

1. Select the storage system.

2. Select **Data Protection** > **TimeFinder** > **TimeFinder/Clone** to open the TimeFinder/Clone dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

**Group level:**
Select a group, click more, and select Set Mode to open the Set Mode - Device Group dialog box.

**Pair level:**

a. Select a group, and click **View Details** to open its **Details** view.

b. Select one or more pairs, click more, and select **Set Mode** to open the **Set Mode - Clone Pair** dialog.

4. Select a **Copy Mode**:

- **Use Copy**—If the session was created without the Copy option, it can be changed now to Copy mode. A copy initiates once the session is activated.

- **Use No Copy**—If the session was created with Copy mode, you can change the session to NoCopy mode. The session becomes CopyOnAccess once the session is activated and no full-volume copy will initiate.

- **Use Precopy**—If the session was created without Precopy, you can change the session to Precopy mode, which implies a copy. You cannot change to NoCopy mode. Once the session is activated, the session changes to Copy mode.

5. Optional: To set session options, click **Show Advanced**, and select any number of options.

6. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Restoring data from target volumes

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.

- With Enginuity 5876 or higher, you can:
  
  - Use ORS control volumes as clone restore targets when the volumes are in PUSH sessions and in the ORS Copied state.
  
  - Perform an incremental restore to a cascaded clone target. For example, in the relationship A->B->C, you can copy data from volume C to volume A.

- With Enginuity 5876, you can perform an incremental restore on volume pairs in a NoCopy/NoDiff clone session.

- With Enginuity 5876.159.102 or higher, you can perform an incremental restore of clone targets to source volumes with active snap and VP snap sessions.

- For a clone session in the Created state, the target volume must be in a fully copied state.
This procedure explains how to copy target data to another volume (full restore), or back to the original source volume (incremental restore).

In the case of a full restore, the original session terminates and a copy session to the target of the restore starts.

In the case of an incremental restore, the original session copy direction is reversed and changed data is copied from the target volume to the source volume. To support this operation, the session must have been created with the Differential option and the volume must be in a fully Copied state.

To restore data from a target volume:

**Procedure**

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Clone to open the TimeFinder/Clone dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   **Group level:**
   - Select a group, click more, and select Restore to open the Restore - Device Group dialog box.

   **Pair level:**
   - Select a group, and click View Details to open its Details view.
   - Select one or more pairs, click more, and select Restore to open the Restore - Clone Pair dialog.
4. Select a Restore Type:
   - **Full Restore** — Terminates the original session and starts a copy session to the target of the restore.
   - **Incremental Restore** — Terminates the original session and starts an incremental copy session back to the original source volume. The session must have been created with the Differential option.
5. If performing the operation at the group level, select the type of source volumes (Source Type) and the type of target volumes (Target Type).
6. To attach Session Options to the operation, click Show Advanced, and select any number of Clone copy session options on page 461.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
Splitting clone volume pairs

Before you begin

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The clone session must be in the Restored state.

This procedure explains how to split clone volume pairs. Splitting volume pairs changes the direction of the clone relationship (that is, the original source volume becomes the source volume for a future copy), which enables you to use either the establish or recreate command.

Procedure

1. To split clone volume pairs:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Clone to open the TimeFinder/Clone dashboard.
   3. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
      
      Group level:
      
      Select a group, click more, and select Split to open the Split - Device Group dialog.
      
      Pair level:
      
      a. Select a group and click View Details to open its Details view.
      
      b. Select one or more pairs, click more, and select Split to open the Split - Clone Pair dialog.
   4. To attach Session Options to the operation, click Show Advanced, and select any number of .
   5. Do one of the following:
      
      - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
      
      - Expand Add to Job List, and click Run Now to perform the operation now.

Terminating clone copy sessions

Before you begin

- TimeFinder/Clone requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You need a clone copy session in any pair state.
- Terminating a session while the pairs are in the CopyOnAccess, CopyOnWrite, or CopyInProg state causes the session to end. If the application has not finished accessing all of the data, the target copy is not a full copy.
This procedure explains how to terminate a clone copy session, thereby deleting the pairing information from the storage system, and removing any hold on the target volume.

**Procedure**

1. To split clone volume pairs:
   1. Select the storage system.
   2. Select **Data Protection > TimeFinder > TimeFinder/Clone** to open the TimeFinder/Clone dashboard.
   3. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
      **Group level:**
      Select a group, click more, and select **Terminate** to open the **Terminate - Device Group** dialog.
      **Pair level:**
      a. Select a group and click **View Details** to open its **Details** view.
      b. Select one or more pairs, click more, and select **Terminate** to open the **Terminate - Clone Pair** dialog.
   4. If performing the operation at the group level, select the type of source volumes (**Source Type**) and the type of target volumes (**Target Type**).
   5. To attach **Session Options** to the operation, click **Show Advanced**, and select any number of **Clone copy session options** on page 461.
   6. Do one of the following:
      - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
      - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Viewing clone copy sessions**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Clone** to open the TimeFinder/Clone view.
3. Select a group, and click **View Details** to open its **Clone Pair List** view.

Use the **Clone Pair List** view to display and manage a group's clone pairs.

The following properties display:

- **Group Details**—Lists additional group details, including:
  - **Group Type**—The type of group. Possible values are: Regular, R1, R2, or R21.
  - **Vendor ID**—The company who's application created the group.
  - **Group Valid**—Whether the group is valid (Yes) or invalid (No).
- **Group Creation Time**—Date and time the group was created.
- **Application ID**—The application that created the group.
- **Group Modify Time**—Date and time the group was last modified.

- **Session List**—Lists the group's clone pairs and their attributes, including:
  - **Source Volume**—The name of the source volume.
  - **Source LDev**—The logical name of the source volume.
  - **Target Volume**—The name of the target volume.
  - **Target LDev**—The logical name of the target volume.
  - **State**—The session state of the pair.
  - **CDGP**—Flags specific to the pair session in the form:
    (C): X = The background copy setting is active for this pair.
    . = The background copy setting is not active for this pair.
    (G): X = The Target volume is associated with a group.
    . = The Target volume is not associated with a group.
    (D): X = The Clone session is a differential copy session.
    . = The Clone session is not a differential copy session.
    (P): X = The precopy operation has completed one cycle.
    . = The precopy operation has not completed one cycle.
  - **Percent Copied**—The percentage of copying that is complete.
  - **Timestamp**—Date and time the snapshot was created.

The following controls are available:

- **Create Pairs**—Creating clone copy sessions on page 450
- **Activate**—Activating clone copy sessions on page 452
- **Recreate**—Recreating clone copy sessions on page 453
- **View Details**—Viewing clone session details on page 460
- **Split**—Splitting clone volume pairs on page 458
- **Restore**—Restoring data from target volumes on page 456
- **Create Snapshot**—Creating clone snapshots on page 454
- **Terminate**—Terminating clone copy sessions on page 458
- **Set Mode**—Modifying clone copy sessions on page 455

## Viewing clone session details

**Procedure**

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Clone to open the TimeFinder Clone view.
3. Select a group, and click View Details to open its Clone pair list view.
4. Select a pair and click View Details to open its Details view.
5. Use the clone session Details view to view and manage a clone session.

    The following properties display:
- **Group** — The type of group. Property values: Regular, R1, R2, or R21.
- **Source Volume** — The name of the source volume.
- **Source LDev** — The logical name of the source volume.
- **Target Volume** — The name of the target volume.
- **Target LDev** — The logical name of the target volume.
- **Pair State** — The session state of the pair.
- **Source protected tracks** — Number of protected tracks on the source volume.
- **Source modified tracks** — Number of tracks modified on the source volume.
- **Target protected tracks** — Number of protected tracks on the target volume.
- **Target modified tracks** — Number of modified tracks on the target volume.
- **CDGP** — Flags specific to the pair session in the form:
  -(C): X = The background copy setting is active for this pair.
  . = The background copy setting is not active for this pair.
  -(G): X = The Target volume is associated with a group.
  . = The Target volume is not associated with a group.
  -(D): X = The Clone session is a differential copy session.
  . = The Clone session is not a differential copy session.
  -(P): X = The precopy operation has completed one cycle.
  . = The precopy operation has not completed one cycle.
- **Percent Copied** — The percentage of copying that is complete.
- **Timestamp** — Date and time the pair was created.

### Clone copy session options

The following table describes the TimeFinder/Clone session options:

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Sides</td>
<td>Activates all locally and remotely associated clone pairs in an SRDF group.</td>
<td>Activate Establish</td>
</tr>
<tr>
<td>Concurrent</td>
<td>Performs the action for an additional clone pair in a group.</td>
<td>Create Recreate Establish Activate Verify</td>
</tr>
</tbody>
</table>
Table 6 TimeFinder/Clone session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>Creates clone copies that are consistent with the database up to the point in time that the activation occurs. It suspends writes to the source volumes during the activation.</td>
<td>Activate</td>
</tr>
<tr>
<td>Copy</td>
<td>Creates a full data copy. By omitting this option (default), the volume pair state will be in the CopyOnAccess state when activated. Actual copying of the data is deferred until either tracks on the source volume are written to, or tracks on the target volume are read or written. This option is only applicable when the target volume is a regular volume (not a virtual volume).</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Differential</td>
<td>Used with either the Copy or Precopy option to create an SDDF session for maintaining changed track information. It must be used when creating copy sessions on which you plan on issuing a Restore action.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Create, Establish, Activate, Restore, Split, Terminate</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the target volumes as Not Ready.</td>
<td>Establish, Activate, Restore</td>
</tr>
<tr>
<td>Optimize</td>
<td>Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups. For remote volumes, use the Optimize Rag option.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Optimize Rag</td>
<td>Uses optimization rules to create remote BCV pairs from volumes within the same RDF (RA) group on a storage system.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Precopy</td>
<td>Copies tracks in the background before the clone session is activated. Used with the create and recreate actions.</td>
<td>Create, Recreate</td>
</tr>
<tr>
<td>Restored</td>
<td>With the verify command, verifies that the copy sessions are in the Restored state. With the terminate command, terminates a restored VP Snap session.</td>
<td>Verify, Terminate</td>
</tr>
<tr>
<td>Star</td>
<td>Targets the action at volumes in SRDF/Star mode.</td>
<td>Create, Recreate, Establish, Activate</td>
</tr>
</tbody>
</table>
### Understanding TimeFinder/Snap operations

TimeFinder/Snap operations enable you to create and manage copy sessions between a source volume and multiple virtual target volumes. When you activate a virtual copy session, a point-in-time copy of the source volume is immediately available to its host through the corresponding virtual volume. Virtual volumes consume minimal physical disk storage because they contain only the address pointers to the data that is stored on the source volume or in a pool of SAVE volumes. SAVE volumes are storage volumes that are not host-accessible and can only be accessed through the virtual volumes that point to them. SAVE volumes provide pooled physical storage for virtual volumes.

Snapping data to a virtual volume uses a copy-on-first-write technique. Upon a first write to the source volume during the copy session, Enginuity copies the preupdated image of the changed track to a SAVE volume and updates the track pointer on the virtual volume to point to the data on the SAVE volume.

The attached host views the point-in-time copy through virtual volume pointers to both the source volume and SAVE volume, for as long as the session remains active. If you terminate the copy session, the copy is lost, and the space associated with the session is freed and returned to the SAVE volume pool for future use.

**Note**

TimeFinder operations are not supported directly on storage systems running HYPERMAX OS 5977 or higher. Instead, they are mapped to their TimeFinder/SnapVX equivalents.

The following are the basic actions performed in a TimeFinder/Snap operation:

- **Create**—Creates the relationship between the source volume and the virtual target volume.
- **Activate**—Makes the virtual target volume available for read/write access and starts the copy-on-first-write mechanism.
- **Recreate**—Creates a new point-in-time copy.
- **Restore**—Copies tracks from the virtual volume to the source volume or another volume.
- **Terminate**—Causes the target host to lose access to data pointed to by the virtual volume.
Managing TimeFinder/Snap sessions

Before you begin

TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

The TimeFinder/Snap dashboard provides you with a single place to monitor and manage TimeFinder/Snap sessions on a storage system.

Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Snap to open the TimeFinder/Snap dashboard.

   The following properties display:
   - Device Group—Groups containing volumes using TimeFinder/Snap.
   - Standard—The number of standard volumes in the group.
   - BCV—The number of BCVs in the group.
   - VDEV—The number of virtual volumes in the group.
   - Target—The number of target volumes in the group.
   - State—The session state of the pair.
   - Group Type—The type of group. Property values: Regular, R1, R2, or R21.
   - Group Valid—Whether the group is valid or invalid.

   The following controls are available:
   - Create Pairs—Creating virtual copy sessions on page 464
   - Activate—Activating virtual copy sessions on page 466
   - Terminate—Terminating virtual copy sessions on page 472
   - View Storage Groups—Viewing storage groups (Enginuity 5876) on page 145
   - View Details—Viewing Snap sessions on page 473
   - Restore—Restoring virtual copy sessions on page 471
   - Recreate—Recreating virtual copy sessions on page 470
   - Create Snapshot—Creating snapshots on page 467
   - Duplicate—Duplicating virtual copy sessions on page 469

Creating virtual copy sessions

Virtual copy sessions define and set up the volumes for snap operations.

The Create action defines the copy session requirements and sets the track protection bitmap on the source volume to protect all tracks and detect which tracks are being accessed by the target host or written to by the source host. The target virtual volume remains Not Ready to its host and placed on hold status for copy session usage. This prevents other control operations from using the volume. The volume pair
state transitions from CreateInProg to Created when complete. The virtual data becomes accessible to its host when the copy session is activated

**Note**

- TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- You can create up to 128 copies of a source volume to various virtual target volumes. To do this, enable the following SYMCLI environment variable: SYMCLI_MULTI_VIRTUAL_SNAP = ENABLED.
- A source volume can concurrently copy data to as many as 15 target volumes at one time. Each target requires a separate copy session.
- For storage systems running Enginuity 5876, you can:
  - Use this feature to create multivirtual snap sessions from thin volumes.
  - Use RDF2 async volumes as source volumes.
  - Create a snap pair from a clone target in the Split state.
- To create a snap session of an R2 volume that is in an SRDF/A session, volume level pacing must be enabled on the R1 side.
- Data Domain volumes are not supported.

To create virtual copy sessions:

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **TimeFinder** > **TimeFinder/Snap** to open the **TimeFinder/Snap** dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level.
   - **Group level:**
     a. Select a group, and click **Create Pairs** to open the **Create - Device Group** dialog box.
     b. Select a **Snap Pool**.
     c. Select the type of **Source Volumes**.
     d. Select the type of **Target Volumes**.
   - **Pair level:**
     a. Select a group, and click **View Details** to open its **Details** view.
     b. Select one or more pairs, and click **Create Pairs** to open the **Create Pairs** dialog box.
     c. Click **Set Pairs** to open the **Set Pairs** dialog box.
     d. Select a source volume and a target volume, and click **Add** to make them a pair. Repeat this step as required.
     e. Click **OK** to return to the **Create Sessions** dialog box.
4. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options:
     - To select a **Pairing Type**, expand the menu and select one of the following. If you are not using the **Pairing Type** option, leave this field set to **None**.
       - **Use Exact Pairs** - Allows the system to pair up the volumes in the exact order that they were added to the group.
       - **Use Optimized Pairs** - Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.
     - To attach **Session Options** to the operation, expand the menu, and select any number of options.
     - Do one of the following:
       - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
       - Expand **Add to Job List** and click **Run Now** to perform the operation now.

### Activating virtual copy sessions

Activating the copy session starts the copy-on-first-write mechanism and places the target volume in the Read/Write state. The target host can access the copy and has access to data on the source host until the copy session is terminated.

---

**Note**

TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

To activate virtual copy sessions:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Snap** to open the TimeFinder/Snap dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group, and click **Activate** to open the **Activate** dialog box.
   - **Pair level:**
Creating snapshots

Before you begin

TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to create and immediately activate virtual copy sessions.

Creating snapshots:

Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Snap to open the TimeFinder/Snap dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   Group level:
   Select a group, click more..., and select Create Pairs to open the Create Pairs dialog.

   Pair level:
   a. Select a group, and click View Details to open its Details view.
   b. Select one or more pairs, click more..., and select Create Pairs to open the Create Pairs dialog.
4. Optional: Select Use TGT Volumes to use volumes from a local target list as targets.
5. Optional: If you selected Use TGT Volumes, you can also select to Use BCV Volumes as the source.
6. Do one of the following:
   • Click OK to start the operation now.
   • Click Show Advanced to continue setting the advanced options.
a. To select a Pairing Type, expand the menu, and select one of the following. If you are not using the Pairing Type option, leave this field set to None.

- **Use Exact Pairs**—Allows the system to pair up the volumes in the exact order that they were added to the group.
- **Use Optimized Pairs**—Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.

b. To attach Session Options to the operation, expand the menu, and select any number of options.

c. Click OK.

### Attaching and detaching preferred pairs

Pre-determining attached volume pairs eliminates the need to specify copy session target volumes from within the device group for create and activate operations. The attached pairs are used whenever a snap operation is requested for the specified device group. If a create or activate operation does not specify a volume pair from within the device group, the attached pair is automatically used for the operation.

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**Note**

- TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- You can only attach a standard source volume with a target VDEV. You cannot attach if the source volume is a BCV.

---

To attach/detach preferred pairs:

**Procedure**

1. Select the storage system.
2. Select *Data Protection > TimeFinder > TimeFinder/Snap* to open the *TimeFinder/Snap* dashboard.
3. Select a group, and click **View Details** to open its **Snap Sessions List** view.
4. Do the following to attach preferred pairs:
   a. Select one or more pairs, and click **more**.
   b. Select **Attach** to open the **Attach** dialog box.
   c. To include BCVs, select the **BCV** option.
   d. Select the volumes to attach and click **OK**.
5. Do the following to detach preferred pairs:
   a. Select one or more pairs and click **Detach**.
   b. Click **OK** in the confirmation message.
Duplicating virtual copy sessions

The duplicate TimeFinder/Snap feature allows you to duplicate a point-in-time copy of a virtual volume that is paired in a previously activated snap session to another virtual volume. This second point-in-time copy session actually resides with the source volume of the original snap session and is charged as part of the maximum number of sessions for that source volume. The duplicate snap is an actual copy of the virtual volume to another virtual volume.

Before you begin:

- TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- Snap create and activate operations cannot be mixed between normal snap sessions and duplicate snap sessions within the same operation.
- The maximum number of duplicated sessions in the Created state is two.
- When a duplicate session is in the Created state, the original session cannot be terminated or recreated until the duplicate session is activated.

To duplicate virtual copy session:

Procedure

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Snap** to open the **TimeFinder/Snap** dashboard.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group, click moreенной, and select **Duplicate** to open the **Duplicate** dialog box.
   - **Pair level:**
     - a. Select a group, and click **View Details** to open its **Details** view.
     - b. Select one or more pairs, click moreennifer, and select **Duplicate** to open the **Duplicate** dialog box.
4. Optional: Select **Use TGT Volumes** to use volumes from a local target list as targets.
5. Optional: If you selected **Use TGT Volumes**, you can also select **Use BCV Volumes** as the source.
6. Click one of the following:
   - **OK** to start the operation now.
   - **Show Advanced** to continue setting the advanced options as follows:
     - To attach **Session Options** to the operation, expand the menu, and select any number of options.
     - Click **OK**.
Recreating virtual copy sessions

Before you begin

- TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- For storage systems running Enginuity 5876 or higher, you can use this feature to recreate multivirtual snap sessions from thin and standard volumes.
- This feature can only be used on sessions that have been previously activated.

The snap recreate action allows you to recreate a snap session on an existing VDEV in order to prepare to activate a new point-in-time image.

Procedure

1. To recreate virtual copy sessions:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Snap to open the TimeFinder/Snap dashboard.
   3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

      Group level:
      Select a group, click more and select Recreate to open the Recreate dialog box.

      Pair level:
      a. Select a group, and click View Details to open its Details view.
      b. Select one or more pairs, click more, select Recreate to open the Recreate dialog box.

4. Optional: Select Use TGT Volumes to use volumes from a local target list as targets.

5. Optional: If you selected Use TGT Volumes, you can also select to Use BCV Volumes as the source.

6. Do one of the following:
   - Click OK to start the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options

a. To attach Session Options to the operation, expand the menu, and select any number of options.

b. Click OK.
Restoring virtual copy sessions

Before you begin

- TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- With Enginuity 5876 or higher, you can use ORS control volumes as snap restore volumes when the volumes are in Push sessions and in the ORS Copied state.
- With Enginuity 5876.159.102 and higher, you can perform a TimeFinder/Snap restore to a TimeFinder/Clone target. For example, volumes in an A > B > C cascaded session (where A > B is TimeFinder/Clone and B > C is TimeFinder/Snap) can copy data from volume C to volume A (via volume B). You can complete this operation without terminating the TimeFinder/Clone session, or any existing TimeFinder/Snap sessions off of the TimeFinder/Clone target. This feature is known as Persistent Restore to Target (PTT).

The following types of restore operations can be performed for virtual copy sessions:

- Incremental restore back to the original source volume.
- Incremental restore to a BCV, which has been split from its original standard source volume but maintains the incremental relationship with the source.
- Full restore to any standard or split BCV outside of the existing copy session. The target volume of the restore must be of the same size and emulation type as the source volume.

Procedure

1. To restore virtual copy sessions:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Snap to open the TimeFinder/Snap dashboard.
   3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      
      **Group level:**
      
      Select a group, click more and select Restore to open the Restore dialog box.

      **Pair level:**
      
      a. Select a group, and click View Details to open its Details view.
      b. Select one or more pairs, click more and select Restore to open the Restore dialog.
   4. Select the Restore Type.

   Restore operations can be used to copy target data to another device (full restore), or back to the original source device (incremental restore). In the case of a full restore, the original session terminates and a copy session to the target of the restore starts. In the case of an incremental restore, the original session copy direction is reversed and changed data is copied from the target device to the source device. Restore operations require that the original session is differential and the source device is fully copied.
5. If performing a Full restore, click Set Pairs to open the Set TimeFinder Snap Pairs dialog from which you can select the volumes to use in the operation.

6. Do one of the following:
   - Click OK to start the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options

   a. To attach Session Options to the operation, expand the menu, and select any number of options.
   b. Click OK.

Terminating virtual copy sessions

Before you begin

TimeFinder/Snap requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to terminate an active virtual copy session at any time.

Procedure

1. To terminate virtual copy sessions:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Snap to open the TimeFinder/Snap dashboard.
   3. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:

      Group level:

      Select a group, click more ..., and select Terminate to open the Terminate dialog.

      Pair level:

      a. Select a group, and click View Details to open its Details view.
      b. Select one or more pairs, click more ..., and select Terminate to open the Terminate Sessions dialog box.

4. Optional: Select Use TGT Volumes to use volumes from a local target list as targets.

5. Optional: If you selected Use TGT Volumes, you can also select to Use BCV Volumes as the source.

6. Do one of the following:
   - Click OK to start the operation now.
   - Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options
a. To attach **Session Options** to the operation, expand the menu, and select any number of **options**.

b. Click **OK**.

**Viewing snap pair details**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Snap** to open the **TimeFinder/Snap** view.
3. Select a group, and click **View Details** to open its **Snap Sessions List** view.
4. Select a pair and click **View Details** to open its **Details** view.
5. Use the snap session **Details** view to view and manage a snap session.

The following properties display:

- **Group** — Name of the snap source group.
- **Source Volume** — Name of the source volume.
- **Source LDev** — Logical name of the source volume.
- **Target Volume** — Name of the target volume.
- **Target LDev** — Logical name of the target volume.
- **Pair State** — Session state of the pair.
- **Number of Source Protected Tracks** — Number of protected tracks on the source.
- **SAVE Pool Name** — Name of the snap pool.
- **Percent Copied** — Percentage of copying that is complete.
- **Number of Source Modified Tracks** — Number of tracks modified on the source volume.
- **Number of Target Modified Tracks** — Number of tracks modified on the target volume.

**Viewing Snap sessions**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Snap** to open the **TimeFinder/Snap** dashboard.
3. Select a group, and click **View Details** to open its **Snap Sessions** list view.

   Use the **Snap Sessions** list view to display and manage a group's snap pairs.

   The following properties display:

   - **Group Details** — Lists additional group details, including:
     - **Group Type** — The type of group. Possible values are: Regular, R1, R2, or R21.
• **Vendor ID** — The company who's application created the group.
• **Group Valid** — Whether the group is valid (Yes) or invalid (No).
• **Group Creation Time** — Date and time the group was created.
• **Application ID** — The application that created the group.
• **Group Modify Time** — Date and time the group was last modified.
• **Session List** — Lists the group's clone pairs and their attributes, including:
  • **Source Volume** — The name of the source volume.
  • **Source LDev** — The logical name of the source volume.
  • **Target Volume** — The name of the target volume.
  • **Target LDev** — The logical name of the target volume.
  • **State** — The session state of the pair.
  • **Pool** — The name of the snap pool.
  • **Percent Copied** — The percentage of copying that is complete.
  • **Timestamp** — Date and time the snapshot was created.

The following controls are available:
• **Create Pairs**—Creating virtual copy sessions on page 464
• **Activate**—Activating virtual copy sessions on page 466
• **Terminate**—Terminating virtual copy sessions on page 472
• **View Details**—Viewing snap pair details on page 473
• **Detach**—Viewing clone copy sessions on page 459
• **Attach**—Viewing clone copy sessions on page 459
• **Duplicate**—Duplicating virtual copy sessions on page 469
• **Create Snapshot**—Creating snapshots on page 467
• **Recreate**—Recreating virtual copy sessions on page 470
• **Restore**—Restoring virtual copy sessions on page 471

### Snap session options

The following table describes the TimeFinder/Snap session options:

**Table 7** TimeFinder/Snap session options

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>Causes the source and VDEV pairs to be consistently activated.</td>
<td>Activate</td>
</tr>
<tr>
<td>Duplicate</td>
<td>Indicates that the action is being performed on a duplicate virtual copy session (that is, on a VDEV to a VDEV pair).</td>
<td>Create Activate Terminate</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the</td>
<td>Create Activate</td>
</tr>
</tbody>
</table>
Table 7 TimeFinder/Snap session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Terminate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the VDEVs as Not Ready.</td>
<td>Activate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
<tr>
<td>Restore</td>
<td>Must be used with the terminate action when terminating a restore session.</td>
<td>Terminate</td>
</tr>
<tr>
<td>Star</td>
<td>Indicates that the action is being performed on a volume that is in SRDF/Star mode.</td>
<td>Create</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Activate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recreate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Terminate</td>
</tr>
<tr>
<td>SymForce</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Terminate</td>
</tr>
</tbody>
</table>

Managing TimeFinder SnapVX

TimeFinder SnapVX is a local replication solution designed to non-disruptively create point-in-time copies (snapshots) of critical data. TimeFinder SnapVX creates snapshots by storing changed tracks (deltas) directly in the Storage Resource Pool of the source volume. With TimeFinder SnapVX, you do not need to specify a target volume and source/target pairs when you create a snapshot. If there is ever a need for the application to use the point-in-time data, you can create links from the snapshot to one or more target volumes. If there are multiple snapshots and the application needs to find a particular point-in-time copy for host access, you can link and relink until the correct snapshot is located.

The TimeFinder/SnapVX dashboard provides a single place from you can manage TimeFinder SnapVX snapshots and their associated storage groups.

Secure snapshots — These are Snap VX snapshots that can't be deleted before the expiry time set by the StorageAdmin. Users can create a Secure snapshot or set Secure status on an existing snapshot. Once the retention time has expired, the Secure snapshot will be automatically terminated unless there is a linked device or an active restore session is ongoing. The expiry time on a Secure snapshot can be changed but the time can only be moved forward from the expiry time originally set. This feature requires a VMAX 3 array running the HYPERMAX OS 5977 Q1 2017 Service Release or higher.
Note
Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

Time To Live — From Unisphere for VMAX 8.4 onwards, users can now specify a SnapVX snapshot's time to live in hours as well as days. Previously only days could be specified.

Before you begin
- The storage system must be running HYPERMAX OS 5977 or higher.
- TimeFinder/SnapVX operations are not supported on working ProtectPoint snapshots. TimeFinder/SnapVX operations are, however, supported to help repair failing ProtectPoint snapshots.

To access the TimeFinder/SnapVX dashboard:
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.

TimeFinder/SnapVX dashboard
The following properties display:
- Storage Groups — Storage group associated with the snapshot.
- Capacity — Total capacity of the storage group.
- Snapshots — Number of snapshots associated with storage group.
- Last Creation Time — Date/time the most recent snapshot was created.

The following controls are available:
- Create Snapshot — Creating snapshots on page 476
- Link — Linking to snapshots on page 479
- Restore — Restoring snapshots on page 482
- View Snapshots — Viewing snapshot details on page 487
- Relink — Relinking to snapshots on page 480
- Unlink — Unlinking from snapshots on page 481
- Set Mode — Setting copy mode for snapshots on page 485
- Set Time to Live — Setting snapshots to automatically terminate on page 483
- Set Secure — Setting "Secure" status on an existing snapshot on page 484
- Terminate — Terminating snapshots on page 484
- View Storage Group

Creating snapshots

Before you begin
- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The maximum number of snapshots per source volume is 256.
- Snapshots off of linked targets are permitted only after the volume is fully defined.
The Secure snapshot feature requires the HYPERMAX OS 5977 Q1 2017 Service Release or higher.

You can perform this operation from the following dashboards: TimeFinder/SnapVX, Storage, or Protection. Depending on the location from which you are performing this operation, some of the following steps may not apply.

This procedure explains how to create TimeFinder SnapVX snapshots.

Note

Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

To create snapshots:

Procedure

1. Select the storage system.

2. Do the following, depending on the location from which you want to perform the procedure:

   TimeFinder/SnapVX dashboard:
   a. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
   b. Select a storage group and click Create Snapshot to open the Create Snapshot dialog.

   Storage Groups dashboard:
   a. Select Storage > Storage Groups Dashboard to open the Storage Groups dashboard.
   b. In the Storage Groups panel, click Total or Unprotected to open the corresponding list view.
   c. Select the storage group and click Protect to open the Protect Storage Group wizard.
   d. If not already selected, select Point In Time Protection Using SnapVX.
   e. Click Next.

   Data Protection dashboard:
   a. Select Data Protection > Protection Dashboard to open the Protection dashboard.
   b. In the Storage Group Protection panel, click Total to open the All Storage Groups list view.
   c. Select the storage group and click Protect to open the Protect Storage Group wizard.
   d. If not already selected, select Point In Time Protection Using SnapVX.
   e. Click Next.

3. Select whether to create a new snapshot or reuse an existing snapshot.

4. If reusing an existing snapshot, select it from the list. When using this method, assigns generation numbers to the snapshots in the order in which they were created (latest = generation 0, previous incrementing by one). This naming
convention allows you to differentiate point-in-time copies of the same volumes.

⚠️ **CAUTION**

It is the users responsibility to manage the snapshot names being used. If snapshots are being applied to parent and child storage groups individually, care should be taken to never use the same snapshot name at different levels of the storage group construct. The same applies if some of the volumes are in multiple storage groups being snapshotted; the same snapshot names should also be avoided across the different storage groups.

5. Choose an expiry type from the drop-down menu. The options are:
   - **None** — If no automatic expiry time is set the snapshot will need to be manually deleted.
   - **Time to live** — Once the time you set has expired, the snapshot will be automatically terminated, provided that it is not linked to any target volumes. If an expired snapshot is linked, the system waits until the last link has been removed before terminating the snapshot. To override this behavior and terminate the snapshot, select the **Force** option under the **Show Advanced** link.

6. If you chose **Time to live** as the protection type, use the **Days** and **Hours** drop-down menus to set the snapshot's expiry time.

7. Click **Show Advanced** to see the advanced options. They are:
   - **Secure** — Select this option to set a Secure snapshot that can't be deleted before the expiry time you set. Once you tick the **Secure** checkbox the **Days** and **Hours** drop-down menus will appear and you can use these to set the snapshot's expiry time. Once the retention time has expired, the Secure snapshot will be automatically terminated unless there is a linked device or an active restore session is ongoing. StorageAdmins can choose to move the retention time forward.
   - **Both Sides** — Select this option to create a snapshot at both sides of an SRDF pairing simultaneously. The following limitations apply:
     - A consistent snapshot on both sides is only allowed when the SRDF pairs exist on the source Storage Group volumes in Synchronous RDF mode and the SRDF pair state is Synchronous.
     - A consistent snapshot on both sides is only allowed when the SRDF pairs are in Active SRDF mode and the SRDF pair state is ActiveActive or ActiveBias.
     - A mixture of R1 and R2 devices is not allowed.
     - All the RDF devices in the SG must be in same RDF group.
     - Concurrent RDF is not supported.
     - For cascaded SRDF setups, the Both Sides option is supported by selected Storage Group and the next immediate hop, but not the subsequent hops.
   - **Force** — Select this option to force the operation even though one or more volumes may not be in the normal, expected states.

8. Click **Next**.
9. Choose one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. This option can be used to create a recurring daily SnapVX snapshot for a given time. In the event of a failed recurring snapshot, an Alert will be raised to notify the user. The schedule continues to run in the event of a failed snapshot, issuing alerts to the user. The alerts list view will retain a record of the failed snapshots (unless the alert is deleted). A warning level alert will be issued. There will not be an end date for the schedule specified when setting it up, so you will need to cancel the schedule manually, if desired. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.

### Linking to snapshots

This procedure explains how to link one or more host-mapped target volumes to a snapshot, thereby making the snapshot's point-in-time data available to applications running on the host.

Snapshots can be linked to target volumes in the following modes:

- **NoCopy mode**—Creates a temporary, space-saving snapshot of only the changed data on the snapshot's Storage Resource Pool (SRP). Target volumes linked in this mode will not retain data after the links are removed. This is the default mode. This mode cannot be used when either the source or link target volume is a Data Domain volume.
- **Copy mode**—Creates a permanent, full-volume copy of the data on the target volume's SRP. Target volumes linked in this mode will retain data after the links are removed.

### Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The targets must not be linked to any other snapshots.
- The target volume must be of equal or greater size than the source volume.
- Any pre-existing data that was exclusive to the target will be lost during a link or relink.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.
- The SnapVX link storage group dialog is updated to always create CKD devices when the New storage group target name radio button is selected.

### Procedure

1. To link to snapshots:
   1. Select the storage system.
   2. Select **Data Protection > TimeFinder > TimeFinder/SnapVX** to open the TimeFinder/SnapVX dashboard.
   3. Select the storage group and click **Link** to open the **Link to Storage Group** dialog.
   4. Select the **Snapshot Name** and **Creation Date** (0 is the latest).
5. Specify whether to link to a new target storage group (one not already linked to a snapshot) or an existing target storage group.

6. Optional: Modify the default name for the new storage group.

7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List and click Run Now to perform the operation now.
   - Show Advanced to continue setting the advanced options, as described next.

**Setting advanced options**

- To create a permanent, full-time copy of the data on the target volume's SRP, select Copy. Selecting Copy enables the Remote option.
- To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
- Optional: Uncheck the Compression check box to turn off Compression. Compression is only allowed on VMAX All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.
- Do one of the following:
  - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand Add to Job List and click Run Now to perform the operation now.

**Relinking to snapshots**

This procedure explains how to unlink a target storage group from a snapshot, and then automatically link it to another snapshot. After a relink operation, the copy between the original linked snapshot and the newly linked snapshot is differential.

You can also relink storage group to the same snapshot, thereby refreshing the point-in-time copy on the target storage group when it's been modified by host writes.

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- To relink in Copy mode:
  - The original link must be fully copied prior to the relink.
  - The copy will be differential between the original linked snapshot and the newly linked snapshot.
- Any pre-existing data that was exclusive to the target will be lost during a link or relink.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.
Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select the storage group, click more , and select Relink to open the Relink dialog box.
4. Select the link target Storage group, the new Snapshot Name and Generation (0 is the latest).
5. Click one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   • Expand Add to Job List, and click Run Now to perform the operation now.
   • Show Advanced to continue setting the advanced options, as described next.
     ▪ To create a permanent, full-time copy of the data on the target volume's SRP, select Copy. Selecting Copy enables the Remote option.
     ▪ To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
     ▪ Do one of the following:
       – Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
       – Expand Add to Job List, and click Run Now to perform the operation now.

Unlinking from snapshots

This procedure explains how to unlink target volumes from their snapshots.

For instructions on unlinking target volumes, and then automatically linking to other snapshots, refer to Relinking to snapshots on page 480.

Before you begin

• To perform this operation, you must be a StorageAdmin.
• The storage system must be running HYPERMAX OS 5977 or higher.
• This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select the storage group, click more , and select Unlink to open the Unlink dialog box.
4. Select the **Snapshot Name** and **Creation Date** (0 is the latest).

5. Click one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - **Show Advanced** to continue setting the advanced options, as described next.

**Setting advanced options:**

To force the operation even though one or more volumes may not be in the normal, expected state(s), select **Force**.

To force the operation when the operation would normally be rejected, select **SymForce**.

Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

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**Restoring snapshots**

This procedure explains how to restore snapshot data back to the original source volumes. TimeFinder SnapVX restore operations are inherently differential, meaning that only tracks that have changed since the snapshot was created are copied back to the source volumes.

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/SnapVX** to open the TimeFinder/SnapVX dashboard.
3. Select the storage group and click **Restore** to open the **Restore** dialog box.
4. Select the **Snapshot Name** and **Creation Date** (0 is the latest).
5. Do one of the following:
   - Click **Add to Job List** to perform the operation at a later time, as described in **Scheduling jobs** on page 873.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

**Setting advanced options:**
To force the operation even though one or more volumes may not be in the normal expected state(s), click **Show Advanced** and select **Force**.

### Setting snapshots to automatically terminate

This procedure explains how to configure snapshots to automatically terminate after a period of time.

#### Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

#### Procedure

1. Select the storage system.
2. Select **Data Protection** > **TimeFinder** > **TimeFinder/SnapVX** to open the **TimeFinder/SnapVX** dashboard.
3. Select the storage group, click more ▶️, and select **Set Time to Live** to open the **Set Time to Live** dialog box.
4. Select the **Snapshot Name** and **Creation Date**.
5. Select the amount of days and hours you want the snapshot to exist for.
   
   Once the time has expired, the snapshot is automatically terminated, provided that it is not linked to any target volumes. If an expired snapshot is linked, the system will wait until the last link has been removed before terminating the snapshot. To override this behavior, select the **Force** option, which will allow the system to terminate the snapshot regardless of whether it is linked. To remove the Time to Live attribute, select **None**.

6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs on page 873](#) and [Previewing jobs on page 873](#).
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to continue setting the advanced options, as described next.

   **Setting advanced options:**

   To force the operation even though one or more volumes may not be in the normal, expected state(s), select **Force**.

   Do one of the following:

   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs on page 873](#) and [Previewing jobs on page 873](#).
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Setting "Secure" status on an existing snapshot

Before you begin
To perform this operation, you must be a StorageAdmin.
The Secure snapshot feature requires the HYPERMAX OS 5977 Q1 2017 Service Release or higher.
This procedure explains how to set "Secure" status on an existing snapshot. It can also be performed by clicking on a storage group in the TimeFinder SnapVX view to open the Snapshots view.

Note
Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

Procedure
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX.
3. Select a storage group and click >>. From the menu choose Set Secure.
   The SnapVX Set Secure wizard opens.
4. Select the name of an existing snapshot and then use the Days and Hours drop-down menus to set the expiry time.
5. Click Run Now or Add to Job List.

Terminating snapshots

This procedure explains how to remove snapshots from a system.

Before you begin
- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The snapshot must not have any links.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.
- If the snapshot is Restored, then this action terminates the restore session. If you want to terminate the snapshot, the dialog and action have to be executed again.

Procedure
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select the storage group, click more >>, and select Terminate to open the Terminate dialog box.
4. Select the Snapshot Name and Generation.
5. Do one of the following:
Setting copy mode for snapshots

This procedure explains how to change the copy mode used when linking target volumes and snapshots.

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select the storage group, click more, and select Set Mode to open the Set Mode dialog box.
4. Select the Snapshot Name and Generation.
5. Select a new mode:
   - No Copy—Creates a temporary, space-saving snapshot of only the changed data on the snapshot's Storage Resource Pool (SRP). Target volumes linked in this mode will not retain data after the links are removed. This is the default mode.
Copy—Creates a permanent, full-volume copy of the data on the target volume's SRP. Target volumes linked in this mode will retain data after the links are removed.

6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Show Advanced to continue setting the advanced options, as described next.

   Setting Advanced options:

   To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.

   Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing snapshots

This procedure explains how to view and manage snapshots of a storage group.

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select View Snapshots to open the storage group Snapshots list view.

   The storage group Snapshots list view allows you to view and manage the snapshots associated with a storage group.

   The following properties display:
   - **Snapshot**—Name of the snapshot.
   - **Creation Time**—Date, time, and generation number for the snapshot.
   - **Linked**—Whether the snapshot is linked to another storage group. A checkmark indicates that the snapshot is linked.
   - **Restored**—Whether the snapshot is restored to the source. A checkmark indicates that the snapshot is restored.
   - **Tracks**—Number of tracks that have been allocated to preserve the point in time copy of the source volume since the snapshot was created.
   - **Secured**—Whether the snapshot is Secured or not. A checkmark indicates that the snapshot is Secured, a dash indicates that it isn't. "Expired" indicates that the snapshot was Secured but is now expired.
   - **Non-Shared Tracks**—Number of tracks uniquely allocated for the snapshot's delta.
Viewing snapshot details

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select View Snapshots to open the storage group Snapshots list view.
4. Select a snapshot and select View Details to open the snapshot Details view.

The Snapshot Details view allow you to view and manage a snapshot. It contains Properties and Related Objects panels.

Properties panel

The following properties display:

- **Name**—Name of the snapshot. To rename the snapshot, type a new name over the existing and click Apply. Snapshot names must be unique from other snapshots on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Snapshot names are case-sensitive. You are responsible for naming snapshots, and you should avoid using the same snapshot names in different containers like a storage group.

- **Generation**—Generation number assigned to the snapshot. This number is used to differentiate between point-in-time copies of the same name and same volumes. Assigns generation numbers to the snapshots in the order in which they were created (latest = generation 0, previous incrementing by one).

- **Creation Date**—Date and time the snapshot was created.

- **Expiry Date**—Date and time the snapshot is set to automatically terminate if either "Secure" or "Time to Live" has been set. If the snapshot is not set to automatically terminate, this field displays N/A.

- **State**—Snapshot state.
Secured—Indicates whether the snapshot is Secured or not. A checkmark indicates that the snapshot is Secured, a dash indicates that it isn't. "Expired" indicates that the snapshot was Secured but is now expired.

The following controls are available:

- **Apply**—Applies changes made in the Properties list, for example, renaming the storage group.
- **Cancel**— Cancels changes made in the Properties list.

**Related Objects** panel

The Related Objects panel links you to views displaying objects contained in and associated with the snapshot. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Links - 2 opens a view listing the two links associated with the snapshot.

### Viewing snapshot links

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select View Snapshots to open the storage group Snapshots list view.
4. Select a snapshot and select View Details to open the snapshot Details view.
5. In the Related Objects panel, click Links to open the snapshot Links list view.

The snapshot Links list view allow you to view and manage the storage groups containing the linked volumes.

The following properties display:

- **Storage Group**—Name of the storage group.
- **State**—Snapshot state.
- **Snapshot Timestamp**—Date and time the snapshot was created.
- **Link Creation Timestamp**—Date and time the link was created.
- **Tracks**—Number of source tracks that the host has not yet overwritten.
- **Track Size**—Track size in bytes.
- **Percent Copied**—Percent of the total source volume size that has been overwritten by the host.

The following controls are available:

- **Link**—Linking to snapshots on page 479
- **Relink**—Relinking to snapshots on page 480
- **View Details**—Viewing snapshot link details on page 489
Viewing snapshot link details

This procedure explains how to view snapshot link pairs.

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
1. To view snapshot source volumes:
   1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select View Snapshots to open the storage group Snapshots list view.
4. Select a snapshot and select View Details to open the snapshot Details view.
5. In the Related Objects panel, click Links to open the snapshot links list view.
6. Select a link and click View Details to open the snapshot link Details view.

The snapshot link Details view allow you to view and manage the linked volume pairs.

The following properties display:
- **Source Volume**—Name of the source volume.
- **Link Volume**—Name of the linked volume.
- **State**—Snapshot state.
- **Snapshot Timestamp**—Date and time the snapshot was created.
- **Link Creation Timestamp**—Date and time the link was created.
- **Flags**—Snapshot flags. Possible values are: Failed, Copied, Modified, Defined (FCMD).
- **Percent Copied**—Percent of the total source volume size that has been overwritten by the host.

The following controls are available:
- **Relink**—Relinking to snapshots on page 480
- **Unlink**—Unlinking from snapshots on page 481

Viewing snapshot source volumes

This procedure explains how to view the source volumes in snapshot.

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

This view displays SnapVX ICDP snapshots created from the Mainframe product. Management of these snapshots is not supported.

Procedure
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/SnapVX to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select **View Snapshots** to open the storage group **Snapshots** list view.

4. Select a snapshot and select **View Details** to open the snapshot **Details** view.

5. In the **Related Objects** panel, click **Source Volumes** to open the snapshot **Source Volumes** list view.

The snapshot **Source Volumes** view allow you to view and manage the source volumes in a snapshot.

The following properties are displayed:

- **Name**—Name of volume
- **State**—Snapshot state.
- **Creation Date**—Date and time the snapshot was created.
- **Flags**—Snapshot flags. Possible values are: Failed, Link, Restore, GCM, Type (FLRGFT).
- **Percent Copied**—Percent of the total source volume size that has been overwritten by the host.
- **Capacity (GB)**—Capacity of the volume.

The following controls are available:

- **Link**—Linking to snapshots on page 479
- **Restore**—Restoring snapshots on page 482
- **Relink**—Relinking to snapshots on page 480
- **View Details**—Viewing snapshot source volume details on page 490
- **Unlink**—Unlinking from snapshots on page 481
- **Set Mode**—Setting copy mode for snapshots on page 485
- **Set Time to Live**—Setting snapshots to automatically terminate on page 483
- **Set Secure**—Setting "Secure" status on an existing snapshot on page 484
- **Terminate**—Terminating snapshots on page 484

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**Viewing snapshot source volume details**

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **TimeFinder** > **TimeFinder/SnapVX** to open the **TimeFinder/SnapVX** dashboard.
3. Select a storage group and select **View Snapshots** to open the storage group **Snapshots** list view.
4. Select a snapshot and select **View Details** to open the snapshot **Details** view.
5. In the **Related Objects** panel, click **Source Volumes** to open the snapshot **Source Volumes** list view.
6. Select the volume and click **View Details** to open the snapshot source volume **Details** view.
The snapshot source volume Details view allows you to view and manage the source volume in a snapshot.

The following properties display:

- **Name**—Name of the volume.
- **State**—Snapshot state.
- **Timestamp**—Date and time the snapshot was created.
- **Child Storage Group**—Name of the child storage group containing this volume. If the volume is not in a child storage group, this field contains N/A.
- **Flags**—Snapshot flags. Possible values are: Failed, Link, Restore, GCM, Type (FLRGFT).
- **Tracks**—Number of source tracks that the host has not yet overwritten.
- **Track Size**—Track size in bytes.
- **Capacity (GB)**—Capacity of the volume.

### Viewing snapshot source volume linked volumes

This procedure explains how to view linked volumes for a snapshot source volume.

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **TimeFinder** > **TimeFinder/SnapVX** to open the TimeFinder/SnapVX dashboard.
3. Select a storage group and select **View Snapshots** to open the storage group Snapshots list view.
4. Select a snapshot and select **View Details** to open the snapshot Details view.
5. In the **Related Objects** panel, click **Source Volumes** to open the snapshot Source Volumes list view.
6. Select the volume and click **View Details** to open the snapshot source volume Details view.
7. In the **Related Objects** panel, click **Link Volumes** to open the snapshot source volume Link Volumes list view.

The snapshot source volume Link Volumes list view allow you to view and manage the linked volumes for a snapshot source volume.

The following properties display:

- **Name**—Name of the volume.
- **Storage Group**—Storage group that contains the target volume.
- **State**—Snapshot state.
- **Snapshot Timestamp**—Date and time the snapshot was created.
- **LinkTimestamp**—Date and time the link was created.
- **Capacity (GB)**—Capacity of the volume.
- **Flags**—Snapshot flags. Possible values are: Failed, Copied, Modified, Defined (FCMD).
Percent Copied—Percent of the total source volume size that has been overwritten by the host.

The following controls are available:

- **Relink**—Relinking to snapshots on page 480
- **Unlink**—Unlinking from snapshots on page 481

## Managing TimeFinder/Mirror sessions

### Before you begin

- TimeFinder/Mirror requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.
- TimeFinder operations are not supported on ORS control volumes on storage systems running HYPERMAX OS 5977 or higher.

The TimeFinder/Mirror dashboard provides you with a single place to monitor and manage TimeFinder/Snap sessions on a storage system.

### Procedure

1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror dashboard.

The following properties display:

- **Source Group**—Lists the groups containing volumes using TimeFinder/Mirror. Information in this column is organized in a tree format, with groups organized into folders according to their type. To view information on a specific group, expand the appropriate folder.
- **Standard**—The number of standard volumes in the group.
- **BCV**—The number of BCVs in the group.
- **State**—The combined state of the sessions in the group. If all the sessions are in the same state, then that state appears; otherwise, **Mixed** appears.
- **Group Type**—The type of group. Property values are: RDF1, RDF2, RDF21, and Regular
- **Group Valid**—Indicates whether the group is valid. Property values are: Yes and No.

The following controls are available:

- **Create Snapshot**—Creating Snapshots on page 493
- **Restore**—Restoring BCV pairs on page 494
- **View Storage Groups**—Viewing storage groups (Enginuity 5876) on page 145
- **Cancel**—Cancelling BCV pairs on page 496
- **Split**—Splitting BCV pairs on page 495
- **View Details**—Viewing mirror pair details on page 497
Creating Snapshots

Before you begin

- TimeFinder/Mirror requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.
- Data Domain volumes are not supported.

Procedure

1. To create snapshots:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror dashboard.
   3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      Group level:
      - Select a device group, and click Create Snapshot to open the Create Snapshot - Device Group dialog.
      Pair level:
      - a. Select a device group, and click View Details to open its Mirror Sessions List view.
      - b. Select one or more pairs, click Create Snapshot to open the Create Snapshot - Mirror Pair dialog.
   4. Select a Snapshot Type:
      - Incremental—Copies to the BCV volume only the new data that was updated on the standard volume while the BCV pair was split.
      - Full—Copies the entire contents of the standard volume to the BCV volume.
   5. If performing a full establish at the pair level, do the following:
      - a. Click Set Pairs to open the Set TimeFinder Mirror Pairs dialog.
      - b. Select a Source Volume and a Target Volume, and click Add to make them a pair. Repeat this step as required.
      - c. Click OK to return to the Create Snapshot - Mirror Pair dialog.
   6. Do one of the following:
      - Click OK to start the operation now.
      - Click Show Advanced to continue setting the advanced options, as described next.
      Setting Advanced options:
        a. To specify Full Snapshot Options, expand the menu, and select one of the following. If you are not using the Full Snapshot Options, leave this field set to None.
        - Use Exact Pairs — Allows the system to pair up the volumes in the exact order that they were added to the group.
- **Use Optimized Pairs** — Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.

b. To attach Session Options to the operation, expand the menu, and select any number of options. For option descriptions, refer to TimeFinder/Mirror session options on page 498.

c. Click **OK**.

## Restoring BCV pairs

**Before you begin**

TimeFinder/Mirror requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to copy data from the BCV volumes to the standard volumes.

**Procedure**

1. To restore BCV pairs:
   1. Select the storage system.
   2. Select **Data Protection** > **TimeFinder** > **TimeFinder/Mirror** to open the **TimeFinder/Mirror** dashboard.
   3. Do the following, depending on whether you want to perform this operation at the group level or the pair level:
      
      **Group level:**
      Select a device group, and click **Restore** to open the **Restore - Device Group** dialog.

      **Pair level:**
      a. Select a device group, and click **View Details** to open the **Mirror Sessions List** view.
      b. Select one or more pairs, and click **Restore** to open the **Restore Mirror Pair** dialog.

   4. Select a **Restore Type**:
      
      - **Incremental**—Copies to the standard volume only the new data that was updated on the BCV volume while the BCV pair was split.
      - **Full**—Copies the entire contents of the BCV volume to the standard volume.

   5. If performing a full establish at the pair level, do the following:
      
      a. Click **Set Pairs** to open the **Set TimeFinder Mirror Pairs** dialog.
      b. Select a **Source Volume** and a **Target Volume**, and click **Add** to make them a pair. Repeat this step as required.
      c. Click **OK** to return to the **Restore - Mirror Pair** dialog.

   6. Do one of the following:
      
      - Click **OK** to start the operation now.
• Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options:

a. To specify Full Restore Options, expand the menu, and select one of the following options. If you are not using the Full Establish Options, leave this field set to None.
   • Use Exact Pairs — Allows the system to pair up the volumes in the exact order that they were added to the group.
   • Use Optimized Pairs — Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.

b. To attach Session Options to the operation, expand the menu, and select any number of options, as described in TimeFinder/Mirror session options on page 498.

c. Click OK.

Splitting BCV pairs

Before you begin
TimeFinder/Mirror requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to split paired volumes to where each holds separate valid copies of the data.

Procedure

1. To split BCV pairs:
   1. Select the storage system.
   2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror dashboard.
   3. Do the following, depending on whether you want to perform this operation at the group level or the pair level:
      Group level:
      Select a device group, and click Split to open the Split - Device Group dialog.
      Pair level:
      a. Select a device group, and click View Details to open the Mirror Sessions List view.
      b. Select one or more pairs, and click Split to open the Split Mirror Pair dialog box.

4. Do one of the following:
   • Click OK to start the operation now.
   • Click Show Advanced to continue setting the advanced options, as described next.

Setting Advanced options
a. To attach Session Options to the operation, expand the menu, and select any number of options, as described in TimeFinder/Mirror session options on page 498.

b. Click OK.

Cancelling BCV pairs

TimeFinder/Mirror requires Enginuity version 5773 or 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

To cancel the relationship between volumes in a BCV pair:

Procedure

1. Select the storage system.

2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror dashboard.

3. Do the following, depending on whether you want to perform this operation at the group level or the pair level.

   Group level:
   - Select a device group, click more , and select Cancel to open the Cancel - Device Group dialog box.

   Pair level:
   - Select a device group and click View Details to open the Mirror Sessions List view.

   - Select one or more pairs, click more , and select Cancel to open the Cancel Mirror Pair dialog box.

4. Click one of the following:

   - OK to start the operation now.
   - Show Advanced to continue setting the advanced option.

   To attach Session Options to the operation, expand the menu and select any number of options, as described in .

   - Click OK.

Viewing mirror pairs

Procedure

1. Select the storage system.

2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror view.

3. Select a device group, and click View Details to open its Mirror Pairs List view.

4. Use the Mirror Pairs List view to display and manage TimeFinder/Mirror sessions.

The following properties display:

- Show Group Details — Lists additional group details, including:
- **Vendor ID**—The company who's application created the group.
- **Group Creation Time**—Date and time the group was created.
- **Group Valid**—Whether the group is valid (Yes) or invalid (No).
- **Group Modify Time**—Date and time the group was last modified.
- **Application ID**—The application that created the group.
- **Session List**—Lists the group's clone pairs and their attributes, including:
  - **Source Volume**—The hexadecimal ID of the source volume.
  - **Source LDev**—The logical name of the source volume.
  - **Target Volume**—The hexadecimal ID of the target volume.
  - **Target LDev**—The logical name of the target volume.
  - **State**—The session state of the pair.
  - **Percent Copied**—The percentage of copying that is complete.
  - **Timestamp**—Date and time the snapshot was created.

The following controls are available:
- **Create Snapshot**—Creating Snapshots on page 493
- **Restore**—Restoring BCV pairs on page 494
- **Split**—Splitting BCV pairs on page 495
- **View Details**—Viewing mirror pair details on page 497
- **Cancel**—Cancelling BCV pairs on page 496

### Viewing mirror pair details

**Procedure**

1. Select the storage system.
2. Select **Data Protection > TimeFinder > TimeFinder/Mirror** to open the TimeFinder/Mirror view.
3. Select a device group, and click **View Details** to open its **Mirror Pairs List** view.
4. Select a pair and click View Details to open its Details view.
   - **Group**—Group name.
   - **Source Volume**—Hexadecimal ID of the source volume.
   - **Source LDev**—Logical name of the source volume.
   - **Target Volume**—Hexadecimal ID of the target volume.
   - **Target LDev**—Logical name of the target volume.
   - **State**—Session state of the pair.
   - **CDGP**—Flags specific to the pair session in the form:
     - (C): X = The background copy setting is active for this pair.
     - . = The background copy setting is not active for this pair.
     - (G): X = The Target volume is associated with a group.
     - . = The Target volume is not associated with a group.
     - (D): X = The Clone session is a differential copy session.
The Clone session is not a differential copy session.

(P): X = The precopy operation has completed one cycle.

. = The precopy operation has not completed one cycle.

- **Number of source invalid tracks**—Number of invalid tracks owed to the target volume.
- **Number of target invalid tracks**—Number of invalid tracks owed to the source volume.
- **Percent Copied**—Percentage of copying complete.

### TimeFinder/Mirror session options

The following table describes the TimeFinder/Mirror session options:

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass</td>
<td>Bypasses the storage system’s exclusive locks for the local or remote array during mirror operations.</td>
<td>Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Consistent</td>
<td>Causes the standard volumes being managed to be consistently split. Cannot be combined with the Instant option.</td>
<td>Split</td>
</tr>
<tr>
<td>Differential</td>
<td>Indicates that the split operation should initiate a differential data copy from the first mirror set member to the rest of the BCV mirror set members when the BCV pair split is done.</td>
<td>Split</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Full Establish, Incremental Establish, Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Differential</td>
<td>Used with either the Copy or Precopy option to create an SDDF session for maintaining changed track information. This must be used when creating copy sessions on which you plan on issuing a Restore action.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Session option</td>
<td>Description</td>
<td>Available with action</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Create, Establish, Activate, Restore, Split, Terminate</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the target volumes as Not Ready. Upon completion of a split action, the target volumes are set as Not Ready. When a restore is initiated, the standard volumes are set as Not Ready.</td>
<td>Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Optimize</td>
<td>Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups. For remote volumes, use the Optimize Rag option.</td>
<td>Full Establish</td>
</tr>
<tr>
<td>Optimize Rag</td>
<td>Uses optimization rules to create remote BCV pairs from volumes within the same RDF (RA) group on a Symmetrix system.</td>
<td>Full Establish</td>
</tr>
<tr>
<td>Protbcvest</td>
<td>Applies to two-way mirrored BCV volumes. Moves all mirrors of the BCV volume to join the mirrors of the standard volume.</td>
<td>Full Establish, Incremental Establish</td>
</tr>
<tr>
<td>Protect</td>
<td>Indicates that the BCV should be write-protected before initiating a restore operation.</td>
<td>Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Remote</td>
<td>Applicable only for split operations on a BCV RDF1 volume, or a restore operation from a BCV to a STD RDF2 volume. If this option is not specified, then the mode defaults to not propagate the data to the remote mirror of the RDF volume.</td>
<td>Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Reverse</td>
<td>With a split operation, initiates a reverse data copy from one or more fixed BCV mirrors to the first (moving) mirror of the BCV</td>
<td>Full Establish, Incremental Establish, Split</td>
</tr>
</tbody>
</table>
Table 8 TimeFinder/Mirror session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
</table>
|                | upon the completion of the split operation. With an establish or restore operation, requests a verification check that the BCV’s fixed mirror has valid data. If at establish or restore time you anticipate a need to perform future BCV reverse split operations, you must apply a reverse establish or restore so that no invalid tracks on the fixed BCV mirror become used. | Full Restore
|                |                                                                              | Incremental Restore                        |
| Star           | Targets the action at volumes in SRDF/Star mode.                             | Full Establish Restore
|                |                                                                              | Split
|                |                                                                              | Cancel                                      |
| SymForce       | Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss. | Full Establish Restore
|                |                                                                              | Incremental Establish
|                |                                                                              | Split                                       |
|                |                                                                              | Full Restore                                |
|                |                                                                              | Incremental Restore                        |

Setting TimeFinder/Mirror pairs

When establishing or restoring TimeFinder/Mirror pairs, this dialog box allows you to define the pairs used in the operation.

Procedure

1. To define the pairs:
   1. Select the Source Volumes and Target Volumes and click Add to move them to the Selected Pairs table.
2. Click OK.

Set TimeFinder Snap Pairs dialog box

When creating, activating, restoring, or establishing a TimeFinder/Snap pairs, this dialog box allows you to define the pairs used in the operation.

Procedure

1. To define the pairs:
   1. Select the Source Volumes and Target Volumes and click Add to move them to the Selected Pairs table.
2. Click OK.
Adding volumes to device groups

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Select the device group and click Edit to open the Add Volumes to Device Group view.
5. From the list of available volumes select the volumes and click Add to Group.
6. Click OK.

Creating device groups

Before you begin
Target volumes are automatically created by the wizard when the source Storage Group contains CKD volumes.

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Click Create to open the Create Device Group wizard.
5. Type a Device Group Name.
6. Select a Device Group Type.
   Possible values are:
   - Regular — Group can only contain REGULAR volumes.
   - R1 — Group can only contain R1 volumes.
   - R2 — Group can only contain R2 volumes.
   - R21 — Group can only contain R21 volumes.
   - Any — Group can contain any volume type.
7. Click Next.
8. Select the Source of the volumes to use when creating the group; either manual selection, or all the volumes in a storage group.
9. Do the following, depending on the source of the volumes:
   - Manual selection:
     a. Select the Source Volume Type.
     b. Select one or more volumes and click Add to Group.
   - Storage group:
     Type or select the name of the Storage Group.
10. Click Next.
11. Select how to specify the Target Volumes, either manually or automatically.
12. Do the following, depending on how you are specifying the target volumes:

- Automatically:
  
  a. Optional: Select to replicate the source volumes using **TimeFinder/Snap**, **TimeFinder Mirror**, or **TimeFinder/Clone**. The required devices (if they are not found to be already existing and unused) will be created. The BCV devices will be automatically created for the TimeFinder Mirror device group. The VDEV devices will be automatically created for the TimeFinder/Snap device group. The required devices will be automatically created for the TimeFinder/Clone device group.
  
  b. If you are replicating the source volumes with TimeFinder/Clone, select whether to add BCV or STD volumes to the device group. The volumes will be added with the TGT flag.

- Manually:
  
  a. Click **Next**.
  
  b. Select the Target Volume Type.
  
  c. Select one or more volumes and click **Add to Group**.

13. Click **Next**.

14. Verify your selections in the **Summary** page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.

15. Click **Finish**.

**Results**

A window appears that displays the progress of the wizard's tasks.

**Removing volumes from device groups**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools**.
3. Click **Device Groups** to open the **Device Group** list view.
4. Select the device group and click **View Details** to open the **Details** view.
5. In the **Related Objects** panel, click a volume type to open the list view for the volume type.
6. Select one or more volumes and click **Remove**.
7. Click **OK** in the confirmation message.

**Enabling consistency protection**

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To enable consistency protection:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click Storage Groups or Device Groups.

4. Select a group, click more, and select Enable Consistency.

5. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).

6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced. Select the advanced SRDF session options and click OK.

Disabling consistency protection

Before you begin
SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To disable consistency protection:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Select the storage system.
4. Click Storage Groups or Device Groups.
5. Select a group, click more, and select Disable Consistency.
6. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced. Select the advanced SRDF session options and click OK.

Renaming device groups

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Select the device group from the list and click View Details to open the Details view.
5. In the Name field, enter the new device group name and click Apply to save changes.
Deleting device groups

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Select the device group and click Delete.
5. Click Delete in the confirmation message.

Viewing device groups

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.

Use the Device Group list view to view and manage device groups. The following properties display, depending on the operating environment:

- **Name**—User-defined device group name.
- **Group Type**—Device configuration of the devices in the group. Possible values are: Regular, R1, R2, R21, or Any.
- **Standards**—Number of standard devices in the device group.
- **BCVs**—Number of BCV devices in the device group.
- **VDEVs**—Number of virtual devices in the device group.
- **Targets**—Number of target devices in the device group.
- **Gatekeepers**—Number of gatekeeper devices in the device group (Does not apply/display with HYPERMAX OS 5977).
- **Valid**—Indicates whether the device group is valid.

The following controls are available, depending on the operating environment:

- **Create**—Creating device groups on page 501
- **Edit**—Adding volumes to device groups on page 501
- **Delete**—Deleting disk groups on page 290
- **View Details**—
- **Replication QOS**—QOS for replication on page 235
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 896 (Does not apply/display with HYPERMAX OS 5977.)
- **Assign Symmetrix Priority**—Assigning Symmetrix priority to groups of volumes on page 218
- **Set Optimized Read Miss**—Setting optimized read miss on page 223 (Does not apply/display with HYPERMAX OS 5977.)
Viewing device group details

**Procedure**

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Select the device group and click View Details to open the Details view.

   The device group Details view allows you to view and manage a device group. This view contains Properties, Related Objects, and Performance Views panels.

**Properties panel**

The following properties display, depending on the operating environment:

- **Name**—User-defined device group name.
- **Vendor ID**—System vendor ID.
- **Application ID**—Indicates which application created the device group.
- **Valid**—Indicates whether the device group is valid.
- **Device Group Priority QoS**—QoS priority setting for the device group.
- **Dynamic Cache Partition Name**—Dynamic cache partition to which the device group is assigned.
- **Dynamic Group Create Time**—Time the device group was created.
- **Dynamic Group Modify Time**—Time the device group was modified.
- **Symmetrix ID**—Storage system serial number ID.
- **Remote Symmetrix ID**—storage system serial number ID of the remote storage system.
- **RBCV Symmetrix ID**—storage system serial number ID for the remote BCV.
- **RRBCV Symmetrix ID**—storage system serial number ID for remote RBCV.
- **Number of Associated Gatekeepers**—Number of gatekeeper devices in the device group.
- **Number of STD Volumes in Group**—Number of standard devices in the device group.
- **Number of Locally-Associated BCVs**—Number of local BCV devices associated with the device group.
- **Number of Locally-Associated VDEVs**—Number of virtual devices associated with the device group.
- **Number of Locally-Associated TGTs**—Number of local target volumes associated with the device group.
- **Number of Remotely-Associated BCVs (STD SRDF)**—Number of remote BCV devices associated with the device group.
- **Number of Remotely-Associated BCVs (BCV SRDF)**—Number of BCV devices, associated with the device group, to be paired with remotely-attached BCV devices.
- **Number of Remotely-Associated RBCVs (RBCV SRDF)**—Number of remote BCV devices associated with the device group.
- **Number of Remotely-Associated VDEVs**—Number of remote VDEV devices associated with the device group.

- **Number of Remotely-Associated TGTs**—Number of remote target devices associated with the device group.

- **Number of Hop2 BCVs (Remotely-associated Hop2 BCV)**—Number of BCVs on the second hop of the Cascaded SRDF configuration associated with the device group.

- **Number of Hop2 VDEVs (Remotely-associated Hop2 VDEV)**—Number of virtual devices on the second hop of the Cascaded SRDF configuration associated with the device group.

- **Number of Hop2 TGTs (Remotely-associated Hop2 TGT)**—Number of target devices on the second hop of the Cascaded SRDF configuration associated with the device group.

- **Pacing Capable**—Indicates if the device group allows write pacing capability.

- **Group-level Pacing State**—Indicates if the device group is write pacing enabled or disabled.

- **Volume-level Pacing State**—Indicates if the volumes in the device group are write pacing enabled or disabled.

- **Configured Group-level Exempt State**—Indicates if group-level write pacing exemption capability is enabled or disabled.

- **Effective Group-level Exempt State**—Indicates if effective group-level write pacing exemption capability is enabled or disabled.

- **Group Write Pacing Exempt Volumes**—Indicates if the volumes in the device group have write pacing exemption capability enabled or disabled.

- **Cacheless Read Miss**—Cacheless read miss status. Possible values are:
  - Off—Feature is disabled.
  - System Default—storage system determines the appropriate optimized read miss mode.

The following controls are available, depending on the operating environment:

- **Create**—Creating device groups on page 501

- **Edit**—Adding volumes to device groups on page 501

- **Delete**—Deleting disk groups on page 290

- **Replication QOS**—QOS for replication on page 235

- **Apply**—Applies changes made in the Properties list. For example, renaming the storage group.

- **Cancel**— Cancels changes made in the Properties list.

**Related Objects** panel

The Related Objects panel provides links to views for objects contained in or associated with the device group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking BCVs - 2 opens the view listing the two BCV devices contained in the device group.

**Performance Views** panel

The Performance panel links you to the performance analyze views for the group.
Viewing volume details

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click Device Groups to open the Device Group list view.
4. Select the device group and click View Details to open the Details view.
5. In the Related Objects panel, click a volume type to open its list view or click All Volumes to view all volumes in device group.
6. From the device group volume type list view, select a volume and click View Details to open its details view.

This view allows you to view the volume details. The following properties display:

- **Name**—Volume name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (Cylinders)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Storage system on which the volume resides.
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the device group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.
- **SSID**—Subsystem ID.
- **Capacity (Tracks)**—Capacity in tracks.
- **SA Status**—Volume SA status.
- **Host Access Mode**—Host access mode.
- **Pinned**—Whether the volume is pinned.
- **Service State**—Service state.
- **Defined Label Type**—Type of user-defined label.
- **Dynamic RDF Capability**—RDF capability of the volume.
- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status**—Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Copy Pace QoS**—QoS for Copy pace.
- **Copy Pace - RDF**—Copy pace priority during SRDF operations.
- **Copy Pace - Mirror Copy**—Copy pace priority during TimeFinder/Mirror operations.
- **Copy Pace - Clone**—Copy pace priority during TimeFinder(Clone operations.
- **Copy Pace - VLUN**—Copy pace priority during VLUN migration operations.
- **Dynamic Cache Partition Name**—Name of the cache partition.
- **Cacheless Read Miss**—Cacheless read miss status. Possible values are:
  - **Off**—Feature is disabled.
  - **System Default**—storage system determines the appropriate optimized read miss mode.

### Viewing volumes in device group

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Replication Groups and Pools**.
3. Click **Device Groups** to open the **Device Group** list view.
4. Select the device group and click **View Details** to open the **Details** view.

5. In the **Related Objects** panel, click a volume type to open its list view or click **All Volumes** to view all volumes in device group.

Use the view to view and manage the volumes contained in the device group. The following properties display:

- **Name**—Volume name
- **LDev**—Logical device name
- **Volume Config**—Device Configuration
- **Capacity (GB)**—Device capacity in GB
- **Status**—Device status

The following controls are available:

- **Add**—Adding volumes to device groups on page 501
- **Remove**—Removing volumes from device groups on page 502
- **View Details**—Viewing volume details on page 507

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### Viewing SRDF volume pair details

This procedure explains how to view an SRDF pair's SRDF group.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **SRDF** to open the SRDF dashboard.
3. Select a device group from the list and click **View Details** to open the **SRDF Pair List** view.
4. On the **Local** tab, select the pair and click **View Details** to open its details view.
5. In the **Related Objects** panel, click **SRDF Group** to open the Pair's **SRDF Group** view.

The following properties display:

- **Group**—RDF group number.
- **SRDF Group Label**—RDF group label.
- **Remote SRDF Group**—Remote SRDF Group ID.
- **Remote Symmetrix**—Remote Symmetrix ID.
- **SRDF Group Flags**—SRDF group flags.
- **Volume Count**—Number of volumes in the group.

**Copy Jobs**—Maximum number of RDF copy jobs per RDF group.

**Link Limbo (sec)**—Number of seconds (0-10) for the Symmetrix system to continue checking the local RDF link status.

**SRDF/A Flags**—RDFA Flags:

<table>
<thead>
<tr>
<th>(C)onsistency:</th>
<th>X = Enabled, . = Disabled, - = N/A</th>
</tr>
</thead>
</table>

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Managing remote replication sessions

The SRDF dashboard provides a single place to monitor and manage SRDF sessions on a storage system. This includes device groups types R1, R2, and R21.

Unisphere for VMAX provides the ability to monitor and manage the SRDF replication on storage groups directly without the need to map to a device group.

Unisphere for VMAX provides the ability to monitor and manage SRDF/Metro from the SRDF dashboard. SRDF/Metro delivers active-active high availability for non-stop data access and workload mobility – within a data center and across metro distance. It provides array clustering for storage systems running HYPERMAX OS 5977 or higher enabling even more resiliency, agility, and data mobility. SRDF/Metro enables hosts and host clusters to directly access a LUN or storage group on the primary SRDF array and secondary SRDF array (sites A and B). This level of flexibility delivers the highest availability and best agility for rapidly changing business environments.

In an SRDF/Metro configuration, SRDF/Metro utilizes the SRDF link between the two sides of the SRDF device pair to ensure consistency of the data on the two sides. If the SRDF device pair becomes Not Ready (NR) on the SRDF link, SRDF/Metro must respond by choosing one side of the SRDF device pair to remain accessible to the hosts, while making the other side of the SRDF device pair inaccessible. There are two options which enable this, Bias and Witness.

The first option, Bias, is a function of the two VMAX3 arrays taking part in the SRDF/Metro and is a required and integral component of the configuration. The second option, Witness, is an optional component of SRDF/Metro which allows a third VMAX or VMAX3 system to act as an external arbitrator to avoid an inconsistent result in cases where the bias functionality alone may not result in continued host availability of a surviving non-biased array.
Creating SRDF connections

This task provides a mechanism to make a connection to Symmetrix array that is currently not visible to the Unisphere server and to bring the connected array into Unisphere as remote.

Before you begin:
The physical connectivity and zoning must be in place before undertaking this task.

To create SRDF connections:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF Groups.
3. Select an SRDF group, click more, and select Create SRDF Connection to open the Create SRDF Connection wizard.
4. On the Local page, specify the following information:
   - Type a value for the SRDF group label.
   - Select a SRDF Group Number from the list of unused RDFG numbers for the local array.
   - From the list, select a local port to be used by the new SRDF Group.
5. (Optional) Click Next.
6. On the Remote page, specify the following information:
   - Select Scan to scan the SRDF SAN for the port selected on the local page.
   - Select a Remote Symmetrix ID from the list.
   - Type a value for the SRDF Group Number. This is not selectable as there is no knowledge of the remote candidate array's used RDFG numbers at this point.
   - From the list, select a remote port to be used by the new SRDF Group.
7. (Optional) Click Next.
8. On the Summary page, verify your selections. To change any of them, click Back. Note that some changes may require you to make additional changes to your configuration.
9. Click Finish

Results

A SRDF group has been created with a single port on each side. After creation, further SRDF group changes can be performed using Unisphere functionality.

Creating SRDF pairs

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

Starting with Enginuity 5876, you can:

Block the creation of an SRDF pair when the R2 is larger than the R1. This feature requires that you disable the SYMAPI_RDF_CREATEPAIR_LARGER_R2 option in the
SYMAPI options file (enabled by default). For more information on disabling SYMAPI options, refer to the Solutions Enabler Installation Guide.

Create SRDF pairs containing standard and thin volumes, or thin and diskless volumes. To use this feature, the thin and diskless volumes must be on a storage system running Enginuity 5876 or higher, and the standard volume must be on a storage system running Enginuity 5773 or 5876.

Meta volumes are supported on storage systems running Enginuity 5773 or 5876.

On storage systems running HYPERMAX OS 5977 or higher, you can specify a RecoverPoint volume as the R1 volume.

The cascaded R1 -> R21 -> R2 configuration of which an SRDF pair can be part, depends on the Enginuity/HYPERMAX OS version of each of the devices. The following combinations are supported:

Unisphere for VMAX 8.3 provides support for creating RDF pairs in a concurrent RDF in a SRDF/Metro configuration resulting in one Metro RDF mirror and one Async or Adaptive Copy RDF mirror.

**Note**

The following restrictions apply:

- Adding a Metro RDF mirror when the device is already part of an SRDF/Metro configuration.
- Adding a Metro RDF mirror when the device is already an R2 device.
- Adding a non-Metro RDF R2 mirror to a device that has a Metro RDF mirror.
- Adding a Metro RDF mirror when the non-Metro RDF mirror is in Synchronous mode.
- Adding a non-Metro RDF mirror in Synchronous mode when the device is already part of an SRDF/Metro configuration.
- Operations that make the Metro RDF mirror RW on the RDF link are not allowed if the Metro device is the target of the data copy from the non-Metro RDF mirror.
- Operations that make the non-Metro RDF mirror RW on the RDF link and result in the data copy to the Metro device are not allowed if the Metro RDF mirror is RW on the RDF link.
- The Create Pair - Invalidate R1 operation is not allowed on the non-Metro RDF mirror if it results in a Metro device becoming write-disabled (WD).

<table>
<thead>
<tr>
<th>R1</th>
<th>R21</th>
<th>R2</th>
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<tbody>
<tr>
<td>5977</td>
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<td>5876</td>
<td>5977</td>
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If the RDF interaction includes a storage system running HYPERMAX OS 5977 or higher, then the other storage system must be running Enginuity 5876 or higher.

It is possible to create a SRDF/Metro device pair when SRDF/Metro exist in a current group or an empty SRDF group exists on the storage device.

CKD devices are not supported by SRDF/Metro.

Only CKD storage groups are selectable if the volumes chosen are of that emulation.

To create an SRDF pair:

**Procedure**

1. Select the storage system.
2. Select Data Protection > Replication Groups > and Pools > SRDF Groups to open the SRDF Groups list view.
3. Select the SRDF group and click Create Pairs to open the Create SRDF Pairs dialog box. This selection will determine the remote storage system.
4. Select the SRDF Mirror Type to add the volumes.
5. Select the SRDF Mode for the volume pairs.

   Depending on the existing configuration of the volumes in the group, not all modes may be available. The SRDF mode **Active Active** can only be selected if the SRDF Group is empty. If the SRDF Group already contains an Active Active session then the SRDF mode selector is not visible. For a list of possible modes, refer to SRDF group modes on page 582.

6. (Optional) Select the Adaptive Copy Mode. Possible values are:
   - **Enabled: Disk Mode**—When set, the storage system acknowledges all writes to source (R1) volumes as if they were local volumes. New data accumulates on the source (R1) volume and is marked by the source (R1) side as invalid tracks until it is subsequently transferred to the target (R2) volume. The remote director transfers each write to the target (R2) volume whenever link paths become available.
   - **Enabled: WP Mode**—When set, the storage system acknowledges all writes to the source (R1) volume as if it was a local volume. The new data accumulates in cache until it is successfully written to the source (R1) volume and the remote director has transferred the write to the target (R2) volume. This option requires that the source volume is on a storage system running Enginuity version 5773-5876.

7. Type the **Number of Volumes in the Range**.
8. Type or select the number of the first volume in the range of volumes on the local storage system (Local Start Volume).
9. Type or select the number of the first volume in the range of volumes on the remote storage system (Remote Start Volume).
10. (Optional) Depending on the Mirror Type, select to Include Larger R2 volumes in the pair, or to Include Smaller R1 volumes in the pair.
11. (Optional) Click **Add to local Storage group**.
12. (Optional) Click **Add to remote Storage group**.
13. Click **Add to remote Storage group**.
14. Select the storage group to which the remote devices will be added.
15. Click one of the following:
• **OK** to create the pair now.
• **Show Advanced** to set the advanced options, as described next.

Setting Advanced options:

a. Select any number of the following options:

- **Invalidate**—Specifies the mirror to invalidate upon creation, if any. Possible values are:
  - **R1**—Invalidates the R1 mirror. This option is not supported on a volume pair with an R2 volume larger than the R1.
  - **R2**—Invalidates the R2 mirror. Starting with Enginuity 5876, this option is supported on a volume pair with an R2 volume larger than the R1.

- **Establish**—Starts the RDF data copy upon creation. Establish also has Witness and Bias radio buttons which are enabled if the pair is going to be SRDF mode Active (Witness is enabled only if Witness is possible).

- **Restore**—Resumes remote mirroring and initiates a data copy from the target (R2) side to the source (R1) side. Depending on the operation, all (full) or only changed track (incremental) are copied to the source (R1) side. **Restore** also has Witness and Bias radio buttons which are enabled if the pair is going to be SRDF mode Active (Witness will be enabled only if Witness is possible).

- **Use RecoverPoint Tag**—Specifies that the operation will be performed on RecoverPoint volumes.

- **Remote**—Requests a remote data copy flag.

- **Format**—Specifies to clear all tracks on the R1 and R2 sides, ensuring no data exists on either side, and makes the R1 read write to the host. The **Format** option can be used to add devices into an existing SRDF/Metro Configuration, and is allowed if the devices are RW or NR on the RDF link.

- **Consistency Exempt**—Allows you to move volumes to an RDF group supporting an active SRDF/A session without requiring other volumes in the group to be suspended.

- **No WD**—Specifies to not include volumes enabled for reads only.

When launching the **Create Pairs** dialog from a SRDF/Metro group, radio buttons indicating Witness or Bias will be displayed. If Witness is detected this radio button is defaulted to Witness. If Witness is not detected, the radio button group is disabled and defaulted to Bias.

16. **Click OK.**

**Deleting SRDF pairs**

Deleting SRDF pairs cancels the dynamic SRDF pairing by removing the pairing information from the storage system and converting the volumes from SRDF to regular volumes. This operation can be performed on a storage group, a SRDF/Metro, or a device group.

Half deleting SRDF pairs cancels the dynamic SRDF pairing information for one side (R1s or R2s) of the specified volume pairs and converts the volumes from RDF to regular volumes. This operation can only be performed on a device group.
If you select all pairs for a delete pair action, then the option to remove the devices from the device group, or the local or remote Storage Group is not displayed, as it will not render the device group, storage group, or SRDF/Metro unmanageable.

Before you begin:

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To delete SRDF pairs:

Procedure

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups, Device Groups or SRDF/Metro**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level**:
     - Select a group, click more ..., and select **Delete Pair**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select the **Half Delete** option if deleting one side of the volume pair.
     - Optional: Select **Remove from local Storage Groups**, **Remove from remote Storage Groups**, and **Remove from local Storage Groups** if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid.
   - **Pair level**:
     - Select a group and click **View Details**.
     - Select one or more pairs and click **Delete Pair**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     - Select the **Half Delete** option if deleting one side of the volume pair.
     - Optional: Deselect the selected (by default) **Remove from local Storage Groups**, **Remove from remote Storage Groups**, and **Remove from Device Groups** check boxes. If you deselect the selected defaults, you will be warned if the pair deletion results in devices that are no longer...
SRDF protected, and results in the related device groups becoming invalid. This option is not displayed if all pairs are selected.

- Do one of the following:
  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
  - Click **Show Advanced**. Select the advanced **SRDF session options** and click **OK**.

**Moving SRDF pairs**

This procedure explains how to move the SRDF pair from one SRDF group to another. The move type can be a full move or a half move. A half move specifies to move only the local half of the RDF pair. When using this action on an RDF 1 type pair, only the R1 volume is moved. When using this action on an RDF 2 type pair, only the R2 volume is moved.

Before you begin:

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To move SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups** or **Device Groups**.
4. Select a group, click more, and select **Move**.
5. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
6. Select **New SRDF Group**.
7. Select **Move Type**.
8. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced**. Select the advanced **SRDF session options** and click **OK**.

**Setting SRDF mode**

This procedure explains how to set the mode of operation for an SRDF configuration. SRDF modes determine the following:

- How R1 volumes are remotely mirrored to R2 volumes across the SRDF links
- How I/Os are processed in an SRDF solution
When acknowledgments are returned to the production host that issued a write I/O command

Before you begin:

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.
The Adaptive Copy Mode value Enabled: WP Mode is not available if the R1 mirror of an SRDF pair is on a storage system running HYPERMAX OS 5977 or higher.
It is not allowed to set RDF devices in the non-Metro RDF mirror to operate in Synchronous mode.
You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To set SRDF mode:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     - Select a group, click more, and select Set Mode.
     - Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select SRDF Mode, Adaptive Copy Mode and AC Skew to set the type of SRDF session modes.
     - Select Use Consistent to set consistent transition from asynchronous to synchronous mode.
     - Do one of the following:
       - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
       - Expand Add to Job List, and click Run Now to perform the operation now.
       - Click Show Advanced. Select the advanced SRDF session options and click OK.
   - Pair level:
     - Select a group and click View Details
     - Select one or more pairs, click more, and select Set Mode.
     - Select SRDF Mode, Adaptive Copy Mode and AC Skew to set the type of SRDF session modes.
Select **Use Consistent** to set consistent transition from asynchronous to synchronous mode.

Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 873 and *Previewing jobs* on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
- Click **Show Advanced** to set the advanced. Select the advanced *SRDF session options* and click **OK**.

**Viewing SRDF volume pairs**

This procedure explains how to view and manage the volume pairs in a SRDF group.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF** to open the SRDF dashboard.
3. Select a device group from the list and click **View Details** to open the SRDF Pair List view.
   
   The following properties display:
   
   **Show Group Details:**
   
   Displays the following device group properties:
   
   - **Group Valid**—Indicates if device group is valid or invalid for SRDF management.
   - **Application ID**—Application name managing SRDF actions.
   - **Vendor ID**—Vendor name.
   - **Group Creation Time**—Group creation time stamp.
   - **Group Modify Time**—Group modification time stamp.
   - **Remote Symmetrix**—Remote storage system ID
   - **Volume Pacing Exempt State**—Indicates if volume pacing exempt is enabled.
   - **Write Pacing Exempt State**—Indicates if write pacing exempt is enabled.
   - **Effective Write Pacing Exempt State**—Indicates if effective write pacing exempt is enabled.

   **Local tab:**
   
   Displays the following local SRDF link properties:
   
   - **Source Volume**—Source volume ID.
   - **Source LDev**—Source logical volume ID
   - **Group**—SRDF group ID.
   - **Remote Symmetrix**—Remote storage system ID.
   - **Target Volume**—Target volume ID.
   - **State**—State of the RDF volume pairs.
   - **Volume State**—State of the source volume.
   - **Remote Volume State**—State of the remote volume.
SRDF Mode—SRDF copy type.
Local R1 Invalid—Number of invalid R1 tracks on the source volume.
Local R2 Invalid—Number of invalid R2 tracks on the source volume.
Remote R1 Invalid—Number of invalid R1 tracks on the target volume.
Remote R2 Invalid—Number of invalid R2 tracks on the target volume.
Hop2 tab:
Displays the following remote SRDF link properties:
Source LDev—Source logical volume ID
Concurrent Volume—Concurrent volume ID.
SRDF Group—SRDF group ID.
Remote Symmetrix—Remote storage system ID.
Target Volume—Target volume ID.
State—State of the RDF volume pairs.
Volume State—State of the source volume.
Remote Volume State—State of the remote volume.
The following controls are available:
Establish—Establishing SRDF pairs on page 536
Split—Splitting SRDF pairs on page 550
Suspend—Suspending SRDF pairs on page 551
Restore—Restoring SRDF pairs on page 547
View Details—Viewing SRDF volume pair details on page 519
Resume—Resuming SRDF links on page 543
Failover—Failing over on page 537
Failback—Failing back on page 538
Activate SRDF/A—Activating SRDF/A controls to prevent cache overflow on page 532
Deactivate SRDF/A—Deactivating SRDF/A controls on page 533
Invalidate—Invalidating R1/R2 volumes on page 539
Ready—Making R1/R2 volumes ready on page 540
Not Ready—Making R1/R2 volumes not ready on page 541
R1 Update—Updating R1 volumes on page 552
RW Enable—Read/write enabling R1/R2 volumes on page 542
Write Disable—Read/write disabling R1/R2 volumes on page 544
RW Disable R2—Read/write disabling R2 volumes on page 542
Refresh—Refreshing R1 or R2 volumes on page 545
Set Mode—Setting SRDF mode on page 516
Procedure

1. Select the storage system.
2. Select Data Protection > SRDF to open the SRDF dashboard.
3. Select a device group from the list and click View Details to open the SRDF Pair List view.
4. On the Local tab, select the pair and click View Details to open its details view.

This view contains two panels, Properties and Related Objects.

Properties panel

The following properties display:

- **Device Group** — Device group ID.
- **Source Volume** — Source volume ID.
- **Source LDev** — Source logical device ID.
- **SRDF Group** — SRDF Group ID.
- **Remote Symmetrix** — Remote storage system ID.
- **Remote SRDF Group** — Remote SRDF Group ID.
- **Target Volume** — Target volume ID.
- **Pair State** — Indicates volume pair state.
- **SRDF mode** — SRDF copy type.
- **Adaptive Copy Mode** — Indicates if adaptive copy mode is enabled.
- **Consistency State** — Indicates consistency state.
- **Consistency Exempt** — Indicates if consistency is exempt.
- **Link Status** — Indicates link state.
- **SRDF Domino** — Indicates SRDF Domino state.
- **SRDF Hop2 Group** — SRDF Hop2 Group ID.
- **Source Volume Invalid R1 Track Count** — Number of invalid R1 tracks on source volume.
- **Source Volume Invalid R2 Track Count** — Number of invalid R2 tracks on source volume.
- **Source Volume SRDF State** — Indicates source volume SRDF state.
- **Source Volume SRDF Type** — Indicates source volume SRDF type.
- **Source Volume Track Size** — Source volume track size.
- **Target Volume Invalid R1 Track Count** — Number of invalid R1 tracks on target volume.
- **Target Volume Invalid R2 Track Count** — Number of invalid R2 tracks on target volume.
- **Target Volume SRDF State** — Indicates target volume SRDF state.
- **Target Volume Track Size** — Target volume track size.
- **SRDF/A Pacing Capable** — Indicates if the SRDF pair allows write pacing capability.
- **Configured Group-level Exempt State** — Indicates if group-level write pacing exemption capability is enabled or disabled.
Effective Group-level Exempt State—Indicates if effective group-level write pacing exemption capability is enabled or disabled.

Group Level Pacing State—Indicates if group level write pacing is enabled or disabled.

Volume Level Pacing State—Indicates if volume level write pacing is enabled or disabled.

SRDF/A Consistency Protection—Indicates SRDF/A consistency protection state.

SRDF/A Average Cycle Time —Average cycle time (seconds) configured for this session.

SRDF/A Minimum Cycle Time—Minimum cycle time (seconds) configured for this session.

SRDF/A Cycle Number—Indicates target volume SRDF state.

SRDF/A DSE Autostart—Indicates DSE autostart state.

SRDF/A Session Number—SRDF/A session number.

SRDF/A Session Priority—Priority used to determine which SRDF/A sessions to drop if cache becomes full. Values range from 1 to 64, with 1 being the highest priority (last to be dropped).

SRDF/A Duration Of Last Cycle—The cycle time (in secs) of the most recently completed cycle. It should be noted that in a regular case the cycles switch every ~30 sec, however, in most cases the collection interval is in minutes, which means some cycle times will be skipped. This an important counter to look at to figure out if SRDF/A is working as expected.

SRDF/A Flags—RDFA Flags:

<table>
<thead>
<tr>
<th>(C)onsistency:</th>
<th>X = Enabled, . = Disabled, - = N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S)tatus:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>(R)DFA Mode:</td>
<td>S = Single-session, M = MSC, - = N/A</td>
</tr>
<tr>
<td>(M)sc Cleanup:</td>
<td>C = MSC Cleanup required, - = N/A</td>
</tr>
<tr>
<td>(T)ransmit Idle:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(D)SE Status:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>DSE (A)utostart:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
</tbody>
</table>

SRDF/A Uncommitted Track Counts—Number of uncommitted tracks.

SRDF/A Number of Volumes in Session—Number of volumes in session.

SRDF/A Session Uncommitted Track Counts—Number of uncommitted session tracks.

SRDF/A R1 DSE Used Track Count—Number of tracks used for R1 DSE.

SRDF/A R1 Cache In Use Percent—Percent of R1 cache used.

SRDF/A R1 Shared Track Count—Number of R1 shared tracks.

SRDF/A R1 to R2 Lag Time —Time that R2 is behind R1 (RPO). This is calculated as the last cycle time plus the time since last switch. In a regular case, the cycles switch every ~30 sec and the samples are taken every few minutes, therefore this counter may not show very significant data, however,
when cycles elongate beyond the sample time, this counter can help indicate an estimate of the RPO.

**SRDF/A R2 DSE Used Track Count**—Number of tracks used for R2 DSE.

**SRDF/A R2 Cache In Use Percent**—Percent of R2 cache used.

**SRDF/A Session Minimum Cycle Time**—Minimum cycle time (seconds) configured for this session.

**SRDF/A Transmit Idle State**—Indicates SRDF/A transmit idle state.

**SRDF/A Transmit Idle Time**—Time the transmit cycle has been idle.

**Suspended State**—Suspended state.

**Sqar Mode**—Indicates if SRDF pair is in a SQAR configuration.

The following controls are available:

- **Establish**—Establishing SRDF pairs on page 536
- **Split**—Splitting SRDF pairs on page 550
- **Suspend**—Suspending SRDF pairs on page 551
- **Restore**—Restoring SRDF pairs on page 547
- **Resume**—Resuming SRDF links on page 543
- **Failover**—Failing over on page 537
- **Failback**—Failing back on page 538
- **Activate SRDF/A**—Activating SRDF/A controls to prevent cache overflow on page 532
- **Deactivate SRDF/A**—Deactivating SRDF/A controls on page 533
- **Invalidate**—Invalidating R1/R2 volumes on page 539
- **Ready**—Making R1/R2 volumes ready on page 540
- **Not Ready**—Making R1/R2 volumes not ready on page 541
- **R1 Update**—Updating R1 volumes on page 552
- **RW Enable**—Read/write enabling R1/R2 volumes on page 542
- **Write Disable**—Read/write disabling R1/R2 volumes on page 544
- **RW Disable R2**—Read/write disabling R2 volumes on page 542
- **Refresh**—Refreshing R1 or R2 volumes on page 545
- **Set Mode**—Setting SRDF mode on page 516

**Related Objects** panel

The **Related Objects** panel provides links to views for objects contained in and associated with the SRDF group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **SRDF Group** will open a view listing the two volumes contained in the SRDF group.

**Viewing SRDF protected storage group pairs**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF** to open the SRDF dashboard.
3. Click **Storage Groups** to open the Storage Group list view.
4. Select a storage group instance and click View Details to open the Storage Group pair list view.

Two tabs are displayed: Local and Hop2. The non-metro leg of a concurrent RDF pair is viewable in the SRDF/Metro view and the SRDF/Metro leg of the concurrent RDF pair is viewable in the standard RDF view.

The following properties display in the Local tab:

**Source Volume**—The name of the source volume.

**Source Type**—The source type of the source volume.

**SRDF Group**—RDF group number.

**Remote Symmetrix**—Remote Symmetrix ID.

**Target Volume**—The target volume ID.

**State**—The state of the storage group pair. Possible values are:

- Consistent
- Failed Over
- Invalid
- Partitioned
- R1 Updated
- R1 Update in progress
- Suspended
- Synchronization in progress
- Synchronized
- Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

**Volume State**—The state of the source volume.

**Remote Volume State**—The state of the remote volume.

The following properties display in the Hop2 tab:

**Concurrent Volume**—The name of the concurrent volume.

**Symmetrix ID**—Storage system ID.

**SRDF Group**—RDF group number.

**Remote Symmetrix**—Remote Symmetrix ID.

**Target Volume**—The target volume ID.

**State**—The state of the storage group pair. Possible values are:

- Consistent
- Failed Over
- Invalid
- Partitioned
- R1 Updated
- R1 Update in progress
- Suspended
- Synchronization in progress
- Synchronized
- Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

**Volume State**—The state of the source volume.

**Remote Volume State**—The state of the remote volume.

**SRDF Mode**—The SRDF copy mode.

The following controls are available, depending on the operating environment:

**Note**

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

**Note**

The dialogs associated with controls listed below do not display the **Use 2nd Hop** option if the hop2 is SRDF/Metro.

**Note**

In the event of a concurrent SRDF SG where one leg is SRDF/Metro and one is not SRDF/Metro, the action launching the dialog (Metro or non-Metro) preselects the correct RDFG in the combination box and disables edits on it. The selected RDFG is the one for the SRDF mode of the launching SG.

**Establish**—**Establishing SRDF pairs** on page 536

**Split**—**Splitting SRDF pairs** on page 550

**Suspend**—**Suspending SRDF pairs** on page 551

**Restore**—**Restoring SRDF pairs** on page 547

**View Details**—**Viewing SRDF protected storage group pair properties** on page 525

**Resume**—**Resuming SRDF links** on page 543

**Activate SRDF/A**—**Activating SRDF/A controls to prevent cache overflow** on page 532

**Deactivate SRDF/A**—**Deactivating SRDF/A controls** on page 533

**Invalidate**—**Invalidating R1/R2 volumes** on page 539

**Ready**—**Making R1/R2 volumes ready** on page 540

**Not Ready**—**Making R1/R2 volumes not ready** on page 541

**R1 Update**—**Updating R1 volumes** on page 552

**RW Enable**—**Read/write enabling R1/R2 volumes** on page 542
Viewing SRDF protected storage group pair properties

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups**.
4. Select a storage group instance and click **View Details**.
5. Select a storage group pair instance and click **View Details** to open the Storage Group pair list properties view.

The following properties display, depending on the operating environment:

- **Storage Group**—The name of the storage group.
- **Source Volume**—The name of the source volume.
- **SRDF Group**—The SRDF group number.
- **Remote Symmetrix**—The storage system serial number ID of the remote storage system.
- **Remote SRDF Group**—Remote SRDF Group ID.
- **Target Volume**—The target volume ID.
- **Pair State**—The state of the storage group pair.
- **Link Status**—Indicates link state.
- **SRDF Domino**—Indicates SRDF Domino state
- **Source Volume SRDF State**—Indicates SRDF state of source volume.
- **Source Volume SRDF Type**—Indicates SRDF type of source volume.
- **Source Volume Track Size**—Indicates track size of source volume.
- **Target Volume SRDF State**—Indicates SRDF state of target volume.
- **Target Volume Track Size**—Indicates track size of target volume.

**Related Object panel**

The Related Objects panel links you to views displaying objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Masking Views - 2** will open a view listing the two masking views associated with the storage group.

Viewing SRDF/Metro protected storage group pairs

Unisphere for VMAX provides SRDF monitoring and management for SRDF/Metro protected storage groups on storage systems running HYPERMAX OS 5977 or higher. Only single hop SRDF is supported for SRDF/Metro, that is, current or cascaded setups are not supported.
Procedure

1. Select the storage system.
2. Select Data Protection > SRDF to open the SRDF dashboard.
3. Click SRDF/Metro to open the SRDF/Metro storage group list view.
4. Select a storage group instance and click View Details to open SRDF/Metro storage group pair list view.

Two tabs are displayed: Local and Hop2. The non-metro leg of a concurrent RDF pair is viewable in the SRDF/Metro view and the SRDF/Metro leg of the concurrent RDF pair is viewable in the standard RDF view.

The following properties display in the Local tab:

- **Source Volume**—The name of the source volume.
- **Source Type**—The source type of the source volume.
- **SRDF Group**—RDF group number.
- **Remote Symmetrix**—Remote Symmetrix ID.
- **Target Volume**—The target volume ID.
- **State**—The state of the storage group pair. Possible values are:
  - Consistent
  - Failed Over
  - Invalid
  - Partitioned
  - R1 Updated
  - R1 Update in progress
  - Suspended
  - Synchronization in progress
  - Synchronized
  - Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

- **Volume State**—The state of the source volume.
- **Remote Volume State**—The state of the remote volume.

The following properties display in the Hop2 tab:

- **Concurrent Volume**—The name of the concurrent volume.
- **Symmetrix ID**—Storage system ID.
- **SRDF Group**—RDF group number.
- **Remote Symmetrix**—Remote Symmetrix ID.
- **Target Volume**—The target volume ID.
- **State**—The state of the storage group pair. Possible values are:
  - Consistent
  - Failed Over
• Invalid
• Partitioned
• R1 Updated
• R1 Update in progress
• Suspended
• Synchronization in progress
• Synchronized
• Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

**Volume State**—The state of the source volume.

**Remote Volume State** — The state of the remote volume.

**SRDF Mode**—The SRDF copy mode.

The following controls are available, depending on the operating environment:

---

**Note**

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

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**Delete Pair**—Deleting SRDF pairs on page 514

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**Note**

The dialog associated with this control will not display the Hop2 checkbox if the hop2 is not SRDF/Metro.

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**View Details**—Viewing SRDF Metro protected storage group pair properties on page 527

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**Viewing SRDF Metro protected storage group pair properties**

Unisphere for VMAX provides SRDF monitoring and management for SRDF/Metro protected storage groups on storage systems running HYPERMAX OS 5977 or higher. Only single hop SRDF is supported for SRDF/Metro, that is, current or cascaded setups are not supported.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **SRDF/Metro**.
4. Select a storage group instance and click **View Details**.
5. Select a storage group pair instance and click **View Details** to open the SRDF/Metro storage group pair list properties view.

The following properties display, depending on the operating environment:
Storage Group—The name of the storage group.
Source Volume—The name of the source volume.
SRDF Group—The RDF group number.
Remote Symmetrix—The storage system serial number ID of the remote storage system.
Remote SRDF Group—The SRDF group number.
Target Volume—The target volume ID.
Pair State—The state of the storage group pair.
SRDF Mode—The SRDF copy type.
Related Object panel

The Related Object panel links you to views displaying objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view.

Understanding Virtual Witness

The Witness feature supports a third party that the two storage systems consult if they lose connectivity with each other, that is, their SRDF links go out of service. When this happens, the Witness helps to determine, for each SRDF/Metro Session, which of the storage systems should remain active (volumes continue to be read and write to hosts) and which goes inactive (volumes not accessible).

Prior to the HYPERMAX OS 5977 Q3 2016 or higher release, a Witness could only be a third storage system that the two storage systems involved in a SRDF/Metro Session could both connect to over their SRDF links.

The HYPERMAX OS 5977 Q3 2016 or higher release adds the ability for these storage systems to instead use a Virtual Witness (vWitness) running within a management virtual application (vApp) deployed by the customer.

The following Virtual Witness tasks can be performed from Unisphere for VMAX.

Viewing Virtual Witness instances
Adding a Virtual Witness
Viewing Virtual Witness instance details
Enabling a Virtual Witness
Disabling a Virtual Witness
Removing Virtual Witness

Adding SRDF Virtual Witness instances

Before you begin
Unisphere for VMAX provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

A Virtual Witness instance needs to be created for both participating arrays.

See Understanding Virtual Witness on page 528 for additional information.

Procedure

1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools**.
3. Click **SRDF Virtual Witnesses** to open the **SRDF Virtual Witnesses** list view.
4. Click **Add**.
5. Type values for the following:
   - **Witness name** — User-defined Virtual Witness instance name.
   - **IP/DNS** — IPv4 or IPv6 address, or DNS name from embedded Guest that is associated with Virtual Witness instance.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Removing SRDF Virtual Witness instances

**Before you begin**

Unisphere for VMAX provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

You cannot remove a Virtual Witness instance that is in use (protecting one or more SRDF/Metro sessions).

See **Understanding Virtual Witness** on page 528 for additional information.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools**.
3. Click **SRDF Virtual Witnesses** to open the **SRDF Virtual Witnesses** list view.
4. Click **Remove**.
5. Click **OK**.

### Set status for SRDF Virtual Witness instances

**Before you begin**

Unisphere for VMAX provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

The Virtual Witness disable operation may or may not require additional force flags based on if it is currently protecting SRDF/Metro sessions and if an alternate witness is available. If the vWitness is currently protecting Metro Sessions, the storage system performs a search for replacement Witnesses (virtual or physical) to use.

You cannot disable a Virtual Witness instance that is in use (protecting one or more SRDF/Metro sessions).

The **Set Status** operation changes the state of the Virtual Witness instance from enabled to disabled or from disabled to enabled.

See **Understanding Virtual Witness** on page 528 for additional information.
Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click SRDF Virtual Witnesses to open the SRDF Virtual Witnesses list view.
4. Select a Virtual Witness instance and Click Set Status.
5. Do one of the following:
   When enabling a disabled Virtual Witness instance:
   Click OK.
   When disabling an enabled Virtual Witness instance:
   - Select the Use Force check box. The command fails if the virtual Witness is currently in use (protecting a SRDF/Metro Session) and there is another witness (either virtual or physical) that is available to take over for it. The force flag is needed in order to continue.
   - Select the Use SymForce check box. The command fails if the virtual Witness is currently in use (protecting a SRDF/Metro Session) and there is no other witness (either virtual or physical) that is available to take over for it. The symforce flag is needed in order to continue.
   - Do one of the following:
     - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
     - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing SRDF Virtual Witness instances

Before you begin
Unisphere for VMAX provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.
A Virtual Witness needs to be created for both participating arrays.
See Understanding Virtual Witness on page 528 for additional information.

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click SRDF Virtual Witnesses to open the SRDF Virtual Witnesses list view.
   Use the SRDF Virtual Witnesses list view to view and manage Virtual Witness instances.
   The following properties display, depending on the operating environment:
   - Witness name — User-defined Virtual Witness instance name.
   - IP/DNS— IPv4 or IPv6 address, or DNS name from embedded Guest that is associated with Virtual Witness instance.
Port—Port associated with Virtual Witness instance.

State—State of Virtual Witness instance.

Alive—Flag to indicate if the Virtual Witness instance is alive.

In Use—Flag to indicate if the Virtual Witness instance is in use.

Duplicate—Flag to indicate if the Virtual Witness instance is a duplicate. A duplicate witness is a witness which has the same unique ID as another witness on the storage system, for example, in the case where it was added twice.

The following controls are available, depending on the operating environment:

- Set Status—Set status for SRDF Virtual Witness instances on page 529
- Add—Adding SRDF Virtual Witness instances on page 528
- Remove—Removing SRDF Virtual Witness instances on page 529
- View Details—Viewing SRDF Virtual Witnesses details on page 531

Viewing SRDF Virtual Witnesses details

Before you begin

Unisphere for VMAX provides monitoring and management for SRDF/Metro Virtual Witness on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

See Understanding Virtual Witness on page 528 for additional information.

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools.
3. Click SRDF Virtual Witnesses to open the SRDF Virtual Witnesses list view.
4. Select a SRDF Virtual Witness instance and click View Details to open the Details view.

The SRDF Virtual Witness Details view contains Properties and Related Objects panels.

The following properties display:

- Witness name—User-defined witness name.
- IP/DNS—IPv4 or IPv6 address, or DNS name from embedded Guest that is associated with Virtual Witness instance.
- Port—Port associated with Virtual Witness instance.
- Alive—Flag to indicate if the Virtual Witness instance is alive.
- State—State of Virtual Witness instance.
- In Use—Flag to indicate if the Virtual Witness instance is in use.
- lastHeartbeatTimestamp—Time of last heartbeat operation.
- Duplicate—Flag to indicate if the Virtual Witness instance is a duplicate. A duplicate witness is a witness which has the same unique ID as another witness on the storage system, for example, in the case where it was added twice.

Related Objects panel
The **Related Objects** panel provides links to views for objects associated with the Virtual Witness instance. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking **RDF Groups - 1** opens the view listing the RDF Group associated with the Virtual Witness instance.

**Activating SRDF/A controls to prevent cache overflow**

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to activate SRDF/A control actions that detect cache overflow conditions and take corrective action to offload cache or slow down the host I/O rates to match the SRDF/A service rates.

To activate SRDF/A controls:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF** and click **Storage Groups or Device Groups**.
3. Select **Data Protection > SRDF** and click **Storage Groups or Device Groups**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group, click **>>**, and select **Activate SRDF/A**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select **Activate Type**.
     d. Do one of the following:
        - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
        - Expand Add to Job List, and click **Run Now** to perform the operation now.
        - Click **Show Advanced** to set the advanced. Select the advanced options and click **OK**.
   - **Pair level:**
     a. Select a group and click **View Details** to open the SRDF pair list view.
     b. Select a group, click **>>**, and select **Activate SRDF/A**.
     c. Select **Activate Type**.
     d. Do one of the following:
Deactivating SRDF/A controls

Before you begin
SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to deactivate SRDF/A control actions that detect cache overflow conditions and take corrective action.

To deactivate SRDF/A controls:

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click more, and select Deactivate SRDF/A.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select Deactivate Type.
     d. Do one of the following:
        - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
        - Expand Add to Job List, and click Run Now to perform the operation now.
        - Click Show Advanced to set the advanced options and click OK.
   - Pair level:
     a. Select a group and click View Details to open the SRDF pair list view.
b. Select one or more pairs, click more, and select **Deactivate SRDF/A** to open the **Activate SRDF/A SRDF Pair** dialog box.

c. Select **Deactivate Type**.

d. Do one of the following:

- **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

- Click **Show Advanced** to set the advanced. Select the advanced options and click **OK**.

### Deleting SRDF pairs

Deleting SRDF pairs cancels the dynamic SRDF pairing by removing the pairing information from the storage system and converting the volumes from SRDF to regular volumes. This operation can be performed on a storage group, a SRDF/Metro, or a device group.

Half deleting SRDF pairs cancels the dynamic SRDF pairing information for one side (R1s or R2s) of the specified volume pairs and converts the volumes from RDF to regular volumes. This operation can only be performed on a device group.

If you select all pairs for a delete pair action, then the option to remove the devices from the device group, or the local or remote Storage Group is not displayed, as it will not render the device group, storage group, or SRDF/Metro unmanageable.

**Before you begin:**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

**To delete SRDF pairs:**

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups**, **Device Groups** or **SRDF/Metro**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   - Group level:
     - Select a group, click more, and select **Delete Pair**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select the **Half Delete** option if deleting one side of the volume pair.
     - Optional: Select **Remove from local Storage Groups**, **Remove from remote Storage Groups**, and **Remove from local Storage Groups** if the
Deleting SRDF pairs from the SRDF List Volumes View

Before you begin

To delete SRDF pairs from the SRDF List Volumes View:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools to open the SRDF dashboard.
3. Click SRDF Groups.
4. Select a group and click View Details.
5. Click the Volumes related object.
6. Select a volume and click and select Delete Pairs to open the Delete Pair dialog box.
7. Select the **Half Delete** option if deleting one side of the volume pair.

8. Optional: Deselect the selected (by default) **Remove from Local Storage Groups**, **Remove from Remote Storage Groups**, and **Remove from Device Groups** check boxes. If you deselect the selected defaults, you will be warned if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid. This option is not displayed if all pairs are selected.

9. Optional: Select **Use Force**.

10. Click **OK**.

### Establishing SRDF pairs

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

You can run an establish operation on a cascaded R1 -> R21 -> R2 configuration if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.

To establish SRDF pairs:

**Procedure**

1. Select the storage system.

2. Select **Data Protection** > **SRDF** and click **Storage Groups** or **Device Groups**.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level**:
     a. Select a group and click **Establish**.
     b. Select **Full** or **Incremental** session type.
     c. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     d. Select **Witness** or **Bias** (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.
     e. Do one of the following:
       - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
       - **Expand Add to Job List**, and click **Run Now** to perform the operation now.
       - **Click Show Advanced** to set the advanced options and click **OK**.
   - **Pair level**:
a. Select a group and click **View Details** to open the SRDF pair list view.
b. Select one or more pairs and click **Establish**.
c. Select **Full** or **Incremental** establish type.
d. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to set the advanced. Select the advanced options and click **OK**.

### Failing over

In a period of scheduled downtime for maintenance, or after a serious system problem which has rendered either the host or storage system containing the source (R1) volumes unreachable, no read/write operations can occur on the source (R1) volumes. In this situation, the fail over operation should be initiated to make the target (R2) volumes read/write enabled to their local hosts.

The Failing Over operation is not allowed on the non-Metro RDF mirror if it results in a Metro device becoming write-disabled (WD).

#### Before you begin

If the target (R2) volume is on a storage system running HYPERMAX OS 5977 or higher, and the mode of the source (R1) volume is Adaptive Copy Write Pending, SRDF will set the mode to Adaptive Copy Disk.

As a result of a failover (with establish or restore) operation, a cascaded R1 -> R21 -> R2 configuration can be created if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.

To initiate a failover:

#### Procedure

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups** or **Device Groups**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click more [►►], and select **Failover**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     c. Select the fail over.
   - Pair level:
     a. Select a group and click **View Details**.
     b. Select one or more pairs, click more [►►], and select **Failover**.
c. Select the fail over.

5. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 873 and *Previewing jobs* on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to set the advanced SRDF session options. Select the advanced options and click **OK**.

**Failing back**

A fail back operation is performed when you are ready to resume normal SRDF operations by initiating read/write operations on the source (R1) volumes, and stopping read/write operations on the target (R2) volumes. The target (R2) volumes become read-only to their local hosts while the source (R1) volumes are read/write enabled to their local hosts.

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To initiate a failback:

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **SRDF**.
3. Click **Storage Groups** or **Device Groups**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group, click more and select **Failback**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     c. Select any of the available session options, as described in SRDF session options.
   - **Pair level:**
     a. Select a group and click View Details to open the SRDF pair list view.
     b. Select one or more pairs, click more and select **Failback**.
     c. Select any of the available session options, as described in SRDF session options.
5. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 873 and *Previewing jobs* on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Show Advanced** to set the advanced SRDF session options. Select the advanced options and click **OK**.
Swapping SRDF personalities or Half-swapping SRDF/Metro pairs

Before you begin
SRDF requires HYPERMAX OS 5977 or higher.

When the SRDF device pairs of an SRDF/Metro configuration are Not Ready (NR) on the link, and the SRDF pair state is Partitioned, a half swap operation is allowed. If the half swap is issued to the R2, the SRDF link to the R1 must be unavailable.

If the half swap is issued to the R1, the SRDF link to the other side must be available and the SRDF pair must be seen as R1 – R1 (duplicate pair).

To half swap SRDF/Metro pair:

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF.
3. Select a group, click more, and select Half Swap.
4. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to set the advanced SRDF session options. Select the advanced options and click OK.

Invalidating R1/R2 volumes

This procedure explains how to run internal checks to see if a volume swap is valid. To invoke this operation, the RDF pairs at the source must already be Suspended and Write Disabled or Not Ready.

Before you begin
SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To invalidate R1/R2 volumes:

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click more, and select Invalidate.
b. Select R1 or R2 volume type.

c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

- **Pair level:**
  a. Select a group and click View Details to open the SRDF pair list view.
  b. Select one or more pairs, click more, and select Invalidate.
  c. Select side R1 or R2.

5. Do one of the following:

- **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand Add to Job List, and click Run Now to perform the operation now.
- Click Show Advanced to set the advanced. Select the advanced options and click OK.

## Making R1/R2 volumes ready

This procedure explains how to set the R1 (source) or R2 (target) volumes ready to their local hosts.

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To make R1 or R2 volumes ready:

**Procedure**

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group, click more, and select Ready.
     b. Select side R1 or R2.
     c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
   - **Pair level:**
     a. Select a group and click View Details.
     b. Select one or more pairs, click more, and select Ready.
     c. Select R1 or R2 volume type.
Making R1/R2 volumes not ready

This procedure explains how to set the source (R1) or the target (R2) volumes not ready to the local host.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To make R1/R2 volumes not ready:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   a. Group level:
      i. Select a group, click more \( \text{more} \), and select Not Ready.
      ii. Select side R1 or R2.
      iii. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
   b. Pair level:
      i. Select a group and click View Details.
      ii. Select one or more pairs, click more \( \text{more} \), and select Not Ready.
      iii. Select R1 or R2 volume type.

5. Do one of the following:
   a. Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   b. Expand Add to Job List, and click Run Now to perform the operation now.
   c. Click Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.
Read/write disabling R2 volumes

This procedure explains how to read/write disable target (R2) volumes to their local hosts.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To read/write disable R2 volumes:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click $\rightarrow$, and select RW Disable R2.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
   - Pair level:
     a. Select a group and click View Details.
     b. Select one or more pairs, click $\rightarrow$, and select RW Disable R2.
5. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Click Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.

Read/write enabling R1/R2 volumes

This procedure explains how to write enable the R1 (source) or R2 (target) volumes ready to their local hosts.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.
To read/write enable R1/R2 volumes:

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   a. Group level:
      i. Select a group, click more ▶▶, and select RW Enable R2.
      ii. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
      iii. Select RW Enable R1s or RW Enable R2s volume type.
   b. Pair level:
      i. Select a group and click View Details.
      ii. Select one or more pairs, click more ▶▶, and select RW Enable.
      iii. Select R1 or R2 volume type.
5. Do one of the following:
   a. Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   b. Expand Add to Job List, and click Run Now to perform the operation now.
   c. Click Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.

Resuming SRDF links

This procedure explains how to resume I/O traffic on the SRDF links for all remotely mirrored RDF pairs in the group.

Before you begin
SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.
You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To resume SRDF links:

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
Read/write disabling R1/R2 volumes

Before you begin

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to write disable source (R1) volumes/target (R2) volumes to their local hosts.

The Write Disable R1 operation is not allowed on the non-Metro RDF mirror if it results in a Metro device becoming write-disabled (WD).

To write disable R1/R2 volumes:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF and click Storage Groups or Device Groups.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   a. Group level:
      i. Select a group, click more, and select Resume.
      ii. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
   b. Pair level:
      i. Select a group and click View Details.
      ii. Select one or more pairs, click more, and select Resume.
5. Do one of the following:
   a. Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   b. Expand Add to Job List, and click Run Now to perform the operation now.
   c. Click Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.
Refreshing R1 or R2 volumes

The refresh R1 action marks any changed tracks on the source (R1) volume to be refreshed from the target (R2) side. The Refresh R2 action marks any changed tracks on the target (R2) volume to be refreshed from the source (R1) side.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To invoke this operation, the SRDF pair(s) must be in one of the following states:

- Suspended and Write Disabled at the source
- Suspended and Not Ready at the source
- Failed Over with the -force option specified
- This operation is rejected if the target has invalid local (R2) tracks.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To refresh volumes:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   
   - Group level:
     a. Select a group, click more click more, and select Refresh.
b. Select R1 or R2 volume type.
c. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

- **Pair level:**
  This action can also be run from pair level details view. Select a pair and click **View Details**.
  a. Select a group and click **View Details**.
  b. Select one or more pairs, click more ➜, and select **Refresh**.
  c. Select R1 or R2 volume type.

5. Do one of the following:
   - **OK** to start the operation now.
   - Click **Show Advanced** to set the advanced SRDF session options on page 553. Select the advanced options and click **OK**.

### Resetting original device identity

After deleting a SRDF/Metro pair, the unbiased devices keep the new identity. This procedure explains how to reset the original device identity.

**Before you begin**

**Before you begin:**
SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To establish SRDF pairs:

**Procedure**

1. Select the storage system.
2. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. From the Data Protection dashboard:
        1. Select **Data Protection > Protection Dashboard**.
        2. Click **Total** to view the list of all storage groups on the storage system.
        3. Select a former unbiased SRDF/Metro storage group and click **Reset SRDF/Metro Identity** to open the **Reset Original Identity** dialog box.
     b. From the Storage dashboard:
        1. Select **Storage > Storage Groups Dashboard**.
        2. Click **Total** to view the list of all storage groups on the storage system.
        3. Select a former unbiased SRDF/Metro storage group and click **Reset SRDF/Metro Identity** to open the **Reset Original Identity** dialog box.
   - **Pair level:**
     a. Select **Storage > Volumes**.
     b. Filter the view to display volume(s) that were formally part of a SRDF/Metro pair.
     c. Do one of the following:
• Select a volume and click **Reset SRDF/Metro Identity**.
• Select a volume, click **View Details**, and then click **Reset SRDF/Metro Identity**.

3. Do one of the following:
• **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
• Expand **Add to Job List**, and click **Run Now** to perform the operation now.
• Click **Show Advanced** to set the advanced options as described in **SRDF session options** on page 553. Select the advanced options and click **OK**.

**Restoring SRDF pairs**

This procedure explains how to restore data from the target (R2) volumes to the source (R1) volumes. When you fully restore SRDF pairs, the entire contents of the R2 volume is copied to the R1 volume. When you incrementally restore the R1 volume, only the new data that was changed on the R2 volume while the RDF group pair was split is copied to the R1 volume.

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To restore SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **SRDF** and click **Storage Groups** or **Device Groups**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   • Group level:
     a. Select a group, click **>>,** and select **Restore**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select **Full** or **Incremental** restore type.
     d. Select **Witness** or **Bias** (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.
   • Pair level:
     a. Select a group and click **View Details**.
     b. Select one or more pairs and click **Restore**.
4. Do one of the following:
   • **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
Setting bias location

This procedure explains how to set Bias. If Bias is chosen to be set as part of the Suspend operation, the side with the Bias is the side that the host can see after the Suspend operation completes.

To set bias:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click SRDF/Metro.
4. Select a group, click more, and select Set Bias Location.

View the Move Bias setting that moves the Bias from one side to the other (only applicable for SRDF/Metro). This will take effect after this operation is executed. The Bias indicates the side that remains visible to the host.

5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced. Select the advanced SRDF session options and click OK.

Setting the SRDF GCM flag

This procedure supports the setting of the SRDF GCM flag at the Storage Group level and at the individual volume level.

The Geometry Compatible Mode (GCM) parameter modifies how a storage system running HYPERMAX OS 5997 or later manages the size of a volume. When the GCM attribute is set, the volume is treated as ½ a cylinder smaller than its true configured size. This enables a volume on a storage system running HYPERMAX OS 5977 to be paired with a volume on an storage system running Enginuity 5876, when the 5876 volume has an odd number of cylinders.

Before you begin:

SRDF requires HYPERMAX OS 5977 or later.

Procedure

1. Select the storage system.
2. Do the following, depending on whether you want to perform the operation at the group level or volume level:
   - Group level:
     a. From the Data Protection dashboard:
        - Select Data Protection > Protection Dashboard to open the Protection dashboard.
Setting volume status

After deleting an SRDF/Metro pair, the volumes can be in a Not Ready state. This dialog allows you to set the volume state.

Before you begin:

SRDF requires HYPERMAX OS 5977 or later.

To set the volume state:

Procedure

1. Select the storage system.
2. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   - Click **Total** to view the list of all storage groups on the storage system.
   - Select a storage group and click **Set SRDF GCM** to open the **Set GCM** dialog box.
   - Click **On** to set the GCM flag or **Off** to unset the flag.

   Note
   The only way to unset this flag is to unmap the device which requires an outage at the host which would mean losing access to volumes.

   - Click **OK**.

   b. From the Storage Volumes View:

      - Select **Storage > Storage Volumes** to open the **Storage Volumes** view.
      - Select a storage group and click **Set SRDF GCM** to open the **Set GCM** dialog box.
      - Click **On** to set the GCM flag or **Off** to unset the flag.

      Note
      The only way to unset this flag is to unmap the device which requires an outage at the host which would mean losing access to volumes.

      - Click **OK**.

Volume level:

a. From the Storage Volumes Details View:

   - Select **Storage > Storage Volumes** to open the **Storage Volumes** view.
   - Select a storage group and click **View Details** to open the **Storage Volumes** view.
   - Select a volume and click **Set SRDF GCM** to open the **Set GCM** dialog box.
   - Click **On** to set the GCM flag or **Off** to unset the flag.

      Note
      The only way to unset this flag is to unmap the device which requires an outage at the host which would mean losing access to volumes.

      - Click **OK**.
a. From the Data Protection dashboard:
   - Select **Data Protection > Protection Dashboard** to open the **Protection** dashboard.
   - Click **Total** to view the list of all storage groups on the storage system.
   - Select a former unbiased SRDF/Metro storage group and click **Set Volume Status** to open the **Set Volume Status** dialog box.

b. From the Storage dashboard:
   - Select **Storage > Storage Groups Dashboard** to open the **Storage Groups** dashboard.
   - Click **Total** to view the list of all storage groups on the storage system.
   - Select a former unbiased SRDF/Metro storage group and click **Set Volume Status** to open the **Set Volume Status** dialog box.

c. Click **OK**.

---

**Splitting SRDF pairs**

This procedure explains how to stop SRDF pair mirroring.

**Before you begin**

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To split SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF** and click **Storage Groups** or **Device Groups**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - a. Select a group and click **Split**.
     - b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - c. Select **Use Immediate** for immediate split on asynchronous devices.
   - **Pair level:**
     - a. Select a group and click **View Details**.
     - b. Select one or more pairs and click **Split**.
4. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 873 and *Previewing jobs* on page 873.
   - **Expand Add to Job List**, and click **Run Now** to perform the operation now.
Suspending SRDF pairs

This procedure explains how to stop data transfer between SRDF pairs.

Before you begin:

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To suspend SRDF pairs:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF and click Storage Groups or Device Groups.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   • Group level:
     ▪ Select a group and click Suspend.
     ▪ Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     ▪ Select Use Immediate or Use Consistency Exempt
     ▪ Click Move Bias to move the Bias from one side to the other (only applicable for SRDF/Metro). The side with the Bias set is the side that the host can see after the suspend action completes. This option is not allowed until all the devices in the SRDF/Metro config, both new and existing, are in the ActiveActive or ActiveBias SRDF pair state.
     ▪ Do one of the following:
       – Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
       – Expand Add to Job List, and click Run Now to perform the operation now.
       – Click Show Advanced . Select the advanced SRDF session options and click OK.
   • Pair level:
     ▪ Select a group and click View Details
     ▪ Select one or more pairs and click Suspend.
     ▪ Do one of the following:
       – Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more
information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.

- Expand Add to Job List, and click Run Now to perform the operation now.
- Click Show Advanced. Select the advanced SRDF session options and click OK.

Swapping SRDF personalities

This procedure explains how to swap the SRDF volume designations for a specified device group. It changes source (R1) volumes to target (R2) volumes and target (R2) volumes to source (R1) volumes.

Half swapping SRDF personalities swaps one side of the RDF device designations for a specified group. It changes source (R1) volumes to target (R2) volumes or target (R2) volumes to a source (R1) volumes.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

To swap SRDF personalities:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Select a group, click more >>, and select Swap.
5. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
6. For optional Refreshing R1 or R2 volumes on page 545, select R1, R2 or None.
7. For optional half swapping, select Half Swap.
8. Do one of the following:
   - OK to start the operation now.
   - Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.

Updating R1 volumes

This procedure explains how to incrementally update R1 volumes with changed tracks from R2 volumes.

Before you begin

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To update R1 volumes:
Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups or Device Groups.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click more, and click R1 Update.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select Remote if R1 volumes are a remote.
   - Pair level:
     a. Select a group and click View Details.
     b. Select one or more pairs, click more, and select R1 Update.
     c. Select Remote if R1 volumes are a remote.
5. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Show Advanced to set the advanced SRDF session options on page 553. Select the advanced options and click OK.

SRDF session options

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass</td>
<td>Bypasses the exclusive locks for the local and/or remote storage system during SRDF operations. Use this option only if you are sure that no other SRDF operation is in progress on the local and/or remote storage systems.</td>
<td>Establish, Failback, Failover, Restore, Incremental Restore, Split, Suspend, Swap, Write Disable R1, Ready R1, Ready R2, RWDisableR2, Enable, Disable</td>
</tr>
<tr>
<td>Session option</td>
<td>Description</td>
<td>Available with action</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Consistent</td>
<td>Allows only consistent transition from async to sync mode.</td>
<td>Activate</td>
</tr>
<tr>
<td>Consistency Exempt</td>
<td>Allows you to add or remove volumes from an RDF group that is in Async mode without requiring other volumes in the group to be suspended.</td>
<td>Half Move Move Suspend</td>
</tr>
<tr>
<td>Establish</td>
<td>Fails over the volume pairs, performs a dynamic swap, and incrementally establishes the pairs. This option is not supported when volumes operating in Asynchronous mode are read/write on the RDF link. To perform a fail over operation on such volumes, specify the Restore option detailed higher in this table.</td>
<td>Failover</td>
</tr>
<tr>
<td>Force</td>
<td>overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Establish Incremental Establish Restore Incremental Restore Write Disable R1 Ready R1 Ready R2 RWDisableR2 Enable Disable Swap</td>
</tr>
<tr>
<td>Immediate</td>
<td>Causes the suspend, split, and failover actions on asynchronous volumes to happen immediately.</td>
<td>Suspend Split Failover</td>
</tr>
<tr>
<td>NoWD</td>
<td>No write disable - bypasses the check to ensure that the target of operation is write disabled to the host. This applies to the source (R1) volumes when used with the Invalidate R1 option and to the target (R2) volumes when used with the Invalidate R2 option.</td>
<td></td>
</tr>
<tr>
<td>SymForce</td>
<td>Forces an operation on the volume pair including pairs</td>
<td>Restore</td>
</tr>
<tr>
<td>Session option</td>
<td>Description</td>
<td>Available with action</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Incremental Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Write Disable R1</td>
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<tr>
<td></td>
<td></td>
<td>Ready R1</td>
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<tr>
<td></td>
<td></td>
<td>Ready R2</td>
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<tr>
<td></td>
<td></td>
<td>RWDisableR2</td>
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<tr>
<td></td>
<td></td>
<td>Enable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disable Swap</td>
</tr>
<tr>
<td>RecoverPoint Tag</td>
<td>Specifies that the operation will be performed on RecoverPoint volumes.</td>
<td>Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refresh R1 Update</td>
</tr>
<tr>
<td>Refresh R1</td>
<td>Marks any changed tracks on the source (R1) volume to be refreshed from the target (R2) side.</td>
<td>Swap</td>
</tr>
<tr>
<td>Refresh R2</td>
<td>Marks any changed tracks on the target (R2) volume to be refreshed from the source (R1) side.</td>
<td>Swap</td>
</tr>
<tr>
<td>Remote</td>
<td>When performing a restore or failback action with the concurrent link up, data copied from the R2 to the R1 will also be copied to the concurrent R2. These actions require this option.</td>
<td>Restore Incremental Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failback</td>
</tr>
<tr>
<td>Restore</td>
<td>When the fail over swap completes, invalid tracks on the new R2 side (formerly the R1 side) will be restored to the new R1 side (formerly the R2 side). When used together with the Immediate option, the fail over operation will immediately deactivate the SRDF/A session without waiting two cycle switches for session to terminate.</td>
<td>Failover</td>
</tr>
<tr>
<td>Star</td>
<td>Selecting this option indicates that the volume pair is part of an SRDF/Star configuration. SRDF/Star environments are three-site disaster recovery</td>
<td>Establish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failover</td>
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<td></td>
<td></td>
<td>Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
</tbody>
</table>

SRDF session options 555
Session option | Description | Available with action
--- | --- | ---
 | solutions that use one of the following:  
• Concurrent SRDF sites with SRDF/Star  
• Cascaded SRDF sites with SRDF/Star  
This technology replicates data from a primary production (workload) site to both a nearby remote site and a distant remote site. Data is transferred in SRDF/Synchronous (SRDF/S) mode to the nearby remote site (referred to as the synchronous target site) and in SRDF/Asynchronous (SRDF/A) mode to the distant remote site (referred to as the asynchronous target site).  
SRDFR/Star is supported on Enginuity 5773 and 5876. The Solutions Enabler SRDF Family CLI Product Guide contains more information on SRDF/Star. | Split  
Suspend  
Write Disable R1  
Ready R1  
Ready R2  
RWDisableR2  
Enable  
Disable
---
**SRDF session modes**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Copy</td>
<td>Allow the source (R1) volume and target (R2) volume to be out of synchronization by a number of I/Os that are defined by a skew value.</td>
</tr>
<tr>
<td>Adaptive Copy Disk Mode</td>
<td>Data is read from the disk and the unit of transfer across the SRDF link is the entire track. While less global memory is consumed it is typically slower to read data from disk than from global memory. Additionally, more bandwidth is used because the unit of transfer is the entire track. Additionally, because it is slower to read data from disk than global memory, device resynchronization time increases.</td>
</tr>
<tr>
<td>Adaptive Copy WP Mode</td>
<td>The unit of transfer across the SRDF link is the updated blocks rather than an entire track, resulting in more efficient use of SRDF</td>
</tr>
</tbody>
</table>
Mode | Description
--- | ---
| | link bandwidth. Data is read from global memory than from disk, thus improving overall system performance. However, the global memory is temporarily consumed by the data until it is transferred across the link. This mode requires that the device group containing the RDF pairs with R1 mirrors be on a storage system running Enginuity 5773 and 5876.

| Synchronous | Provides the host access to the source (R1) volume on a write operation only after the storage system containing the target (R2) volume acknowledges that it has received and checked the data. |

| Asynchronous | The storage system acknowledges all writes to the source (R1) volumes as if they were local devices. Host writes accumulate on the source (R1) side until the cycle time is reached and are then transferred to the target (R2) volume in one delta set. Write operations to the target device can be confirmed when the current SRDF/A cycle commits the data to disk by successfully de-staging it to the R2 storage volumes. For storage systems running Enginuity 5876, you can put an RDF relationship into Asynchronous mode when the R2 device is a snap source volume. |

| AC Skew | Adaptive Copy Skew - sets the number of tracks per volume the source volume can be ahead of the target volume. Values are 0 - 65535. |

---

### Creating SRDF/A DSE pools

**Before you begin**

SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Click **Create** to open the **Create DSE Pool** dialog box. You can also create DSE pools from the pool details view.
4. Type a **Pool Name**. DSE pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore ( _ ). The name DEFAULT_POOL is reserved for SAVE volumes that are enabled and not in any other pool.
5. Select the volumes to add and do one of the following:
   - Click **OK** to perform the operation now.
   - Click **Show Advanced** to set the advanced options, as described next.

**Setting Advanced options:**
   a. To enable the new pool members when creating the pool, select **Enable New Pool Member**.
   b. Click **OK**.

### Deleting SRDF/A DSE pools

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

**Procedure**
1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool and click **Delete**.
4. Click **Delete** in the confirmation message.

### Adding volumes to SRDF/A DSE pools

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

**Procedure**
1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool and click **Add** to open the **Add Volumes to DSE Pool** dialog box.
4. Select the volumes to add and click **Add to Pool**.
5. Click **OK**.

### Enabling all volumes in SRDF/A DSE pools

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

**Procedure**
1. Select the storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool, click more **>>, and select **Enable All**.
4. Click **OK**.
Disabling all volumes in SRDF/A DSE pools

Before you begin
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF/A DSE Pools to open the SRDF/A DSE Pools list view.
3. Select a pool, click more, and select Disable All.
4. Click OK.

Viewing SRDF/A DSE pools

Before you begin
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF/A DSE Pools to open the SRDF/A DSE Pools list view.

Use this list view to display and manage the SRDF/A DSE pools on a Symmetrix system.
The following properties display:

- Name—Name of the pool.
- Configuration—Configuration of the volumes in the pool.
- Technology—Technology on which the volumes in the pool reside.
- Emulation—Emulation type.
- Pool State—Whether the pool is Enabled or Disabled.
- % Used—Percent of pool used.
- Used (MB)—Total used space in MB.
- Free (MB)—Total free space in MB.

The following controls are available:

- Create DSE Pool—Creating SRDF/A DSE pools on page 557
- Add—Adding volumes to SRDF/A DSE pools on page 558
- Delete—Deleting SRDF/A DSE pools on page 558
- View Details—Viewing SRDF DSE pool details on page 560
- Enable All—Enabling all volumes in SRDF/A DSE pools on page 558
- Disable All—Disabling all volumes in SRDF/A DSE pools on page 559
- Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 234
Viewing SRDF DSE pool details

Before you begin
SRDF/A DSE pools are supported on storage systems running Enginuity 5773 or 5876.

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF/A DSE Pools to open the SRDF/A DSE Pools list view.
3. Select the pool and click View Details to open its Details view.

Use the SRDF/A DSE Pool Details view to display and manage a TimeFinder/Snap pool. It contains Properties, Performance Views, and Related Objects panels.

The following properties display:
- Symmetrix ID—Storage system on which the pool resides.
- Pool Name—Name of the pool.
- Type—Pool type.
- Emulation—Emulation type.
- RAID Protection—Protection level of the volumes in the pool.
- Number of Volumes—Number of volumes in the pool.
- Disabled Volumes—Number of disabled volumes in the pool.
- Enabled Volumes—Number of enabled volumes in the pool.
- Capacity (GB)—Sum of all enabled and disabled volumes in the pool.
- Enabled Capacity (GB)—Sum of all enabled volumes in the pool.
- Free Capacity (GB)—Total free space in MB.
- Technology—Technology on which the volumes in the pool reside.
- State—Whether the pool is Enabled or Disabled.

The following controls are available:
- Create DSE Pool—Creating SRDF/A DSE pools on page 557
- Add—Adding volumes to SRDF/A DSE pools on page 558
- Delete DSE Pool—Deleting SRDF/A DSE pools on page 558
- Apply—Applies changes made in the Properties list.
- Cancel— Cancels changes made in the Properties list.

The Related Objects panel provides links to views for objects contained in and associated with the pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking SAVE Volumes - 2 will open a view listing the two SAVE volumes contained in the pool.

The Performance panel links you to the performance analyze views for the policy.

This panel will display with inactive links if the selected Symmetrix system is not registered for data collection.
Creating TimeFinder/Snap pools

Procedure

1. Select the storage system.

2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.

3. Click Create to open the Create Snap Pool dialog.

4. Type a Pool Name.

Snap pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore (_). The name DEFAULT_POOL is reserved for SAVE volumes that are enabled and not in any other pool.

5. Select one or more volumes and click either of the following:
   - OK — To add the selected volumes.
   - Show Advanced to continue setting the advanced options, as described next.

Setting advanced options:

To enable new volumes in the pool, select Enable New Pool Member.

The Total Enabled Pool Capacity in GB displays.

Adding volumes to TimeFinder/Snap pools

Procedure

1. Select the storage system.

2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.

3. Select a pool and click Add to open the Add Volumes to Snap Pool dialog.

4. Select one or more volumes and click either of the following:
   - OK — To add the selected volumes.
   - Show Advanced to continue setting the advanced options, as described next.

Setting advanced options:

To enable new volumes in the pool, select Enable New Pool Member.

The Total Enabled Pool Capacity in GB displays.

Enabling all volumes in TimeFinder/Snap pools

Procedure

1. Select the storage system.

2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.

3. Select a snap pool, click more, and select Enable All.

4. Click OK.
Disabling all volumes in TimeFinder/Snap pools

Procedure
1. Select the storage system.
3. Select a snap pool, click more, and select Disable All.
4. Click OK.

Deleting TimeFinder/Snap Pools

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click Delete.
4. Click Delete in the confirmation message.

Removing volumes from TimeFinder/Snap pools

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click View Details to open the SAVE Volume list view.
4. Select one or more volumes and click Remove.
5. Click OK.

Viewing TimeFinder/Snap pools

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.

Use the TimeFinder Snap Pools list view to display and manage the TimeFinder/Snap pools on a storage system.

The following properties display:
- Name—Name of the pool.
- Configuration—Configuration of the volumes in the pool.
- Technology—Technology on which the volumes in the pool reside.
- Emulation—Emulation type.
- Pool State—Whether the pool is Enabled or Disabled.
- % Used—Percent of pool used.
Viewing TimeFinder/Snap pool details

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click View Details to open its Details view.

The Snap Pool Details view allows you to view to manage a TimeFinder/Snap pool. It contains Properties, Performance Views, and Related Objects panels.

Properties panel

The following properties display:

- **Symmetrix ID** — Storage system on which the pool resides.
- **Pool Name** — Name of the pool.
- **Type** — Pool type.
- **Emulation** — Emulation type.
- **RAID Protection** — Protection level of the volumes in the pool.
- **Number of Volumes** — Number of volumes in the pool.
- **Disabled Volumes** — Number of disabled volumes in the pool.
- **Enabled Volumes** — Number of enabled volumes in the pool.
- **Capacity (GB)** — Sum of all enabled and disabled volumes in the pool.
- **Enabled Capacity (GB)** — Sum of all enabled volumes in the pool.
- **Free Capacity (GB)** — Total free space in MB.
- **Technology** — Technology on which the volumes in the pool reside.
- **State** — State of the pool (Enabled or Disabled).

The following controls are available:

- **Create Snap Pool** — Creating TimeFinder/Snap pools on page 561
- **Add** — Adding volumes to TimeFinder/Snap pools on page 561
- **Delete** — Deleting TimeFinder/Snap Pools on page 562
Setting SRDF/A group attributes

Procedure

1. Select a storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF groups to open the SRDF groups list view.
3. Select a group, click more, and select SRDF/A Settings to open the Set SRDF/A Settings dialog box.
4. Type the RDFA Min(imum) Cycle Time. This is the minimum amount of time (in seconds) the VMAX will wait before attempting to perform an RDF/A cycle switch. Possible values range from 1 to 60 seconds.
5. Type the RDFA Session Priority. This priority is used to determine which RDF/A session to drop if cache is full. Possible values range from 1 (highest) to 64 (lowest).
6. Enable Transmit Idle to preserve the data in cache (if the link is idle) and then retry transmitting the data. This option must be enabled on both local and remote sides.
7. Click OK.

Viewing SRDF group volumes

This procedure explains how to view the volumes in an SRDF group:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF groups to open the SRDF groups list view.
3. Select the SRDF group and click View Details to open its Details view.
4. In the Related Objects panel, click SRDF Group Volumes to open the SRDF List Volumes view.

The following properties display:
- **Volumes**—Local volume ID.
- **Configuration**—SRDF configuration.
- **Remote Symmetrix**—Remote storage system ID.
- **Remote SRDF Group**—Remote SRDF group ID.
- **Target Volume**—Target volume ID.
- **State**—Session state of the pair
- **Pair State**—Volume pair state.
- **Remote Volume State**—State of the remote volume.
- **SRDF Mode**—SRDF copy type.

### Viewing SRDF protected storage groups

Unisphere for VMAX 8.1 and higher provides SRDF monitoring and management for storage groups. See Managing remote replication sessions on page 510 for additional information.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups** to open the **Storage Group** list view.

The following properties display, depending on the operating environment:

- **Storage Group**—User-defined storage group name. Parent storage groups are preceded by an arrow (>) icon. Click the icon to view child storage groups.
- **Capacity(GB)**—Total capacity of the storage group in GB.
- **State** — The state of the storage group. Possible values are:
  - Consistent
  - Failed Over
  - Invalid
  - Partitioned
  - R1 Updated
  - R1 Update in progress
  - Suspended
  - Synchronization in progress
  - Synchronized
  - Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The **Storage Group** list view must be refreshed so that the latest state is reflected.
Disabling device groups

This procedure explains how to disable consistency protection for a device group consisting of SRDF/A volumes.
Procedure
1. Select the storage system.
2. Select Data Protection > Remote Replication and expand the Device Groups folder.
3. Select a group, click more, and select Disable to open the Disable Device Group dialog box.
4. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
5. Click one of the following:
   - OK to start the operation now.
   - Show Advanced to set the advanced SRDF session options. Select the advanced options and click OK.

Creating SRDF groups

SRDF groups provide a collective data transfer path linking volumes of two separate storage systems. These communication and transfer paths are used to synchronize data between the R1 and R2 volume pairs associated with the RDF group. At least one physical connection must exist between the two storage systems within the fabric topology.

Before you begin:

The maximum number of supported RDF groups differs by Enginuity version:

<table>
<thead>
<tr>
<th>Enginuity</th>
<th>Maximum number of RDF Groups supported</th>
<th>Group numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>per storage system</td>
<td>per director</td>
</tr>
<tr>
<td>5773</td>
<td>128</td>
<td>32</td>
</tr>
<tr>
<td>5977 or higher</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>5876 or higher</td>
<td>250</td>
<td>64</td>
</tr>
</tbody>
</table>

- When specifying a local or remote director for a VMAX system running HYPERMAX OS 5977, you can select one or more SRDF ports.
- If the RDF interaction includes a storage system running HYPERMAX OS 5977, then the other storage system must be running Enginuity 5876 or higher. In addition, in this interaction the maximum storage system volume number allowed on the system running VMAX OS 5977 is FFFF (65635).

To create an SRDF group:

Procedure
1. Select the storage system.
2. Select Data Protection > Common Tasks > Create SRDF groups.
3. Select a Communication Protocol to use when moving data across the SRDF links.
   The value you select here will populate the Director list.
4. Type an SRDF Group Label (name).
5. Type an SRDF Group Number.
6. Select the local Director through which the group will communicate.
7. To refresh the remote storage system information, click Scan.
8. Optional: Select the Remote Symmetrix ID.
9. Type a Remote SRDF Group Number.
10. Select the Remote Director through which the group will communicate.
11. Click SRDF/Metro Witness Group. This checkbox is selectable when the local storage system and the remote selected storage system are both Witness capable.
12. Click one of the following:
   - OK
   - Show Advanced to set the advanced options, as described next.

Setting Advanced options:

a. Select a Link Limbo Period. This is a length of time for the storage system to continue checking the local SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.

b. Select (enable) Link Domino for the local group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) devices is always in synch.

c. Select (enable) Auto Link Recovery for the local group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.

d. Select (enable) Software Compression for the local group. This enables SRDF software data compression for SRDF groups defined on GigE, or Fibre Channel. Although you can enable/disable software compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or higher.

e. Select (enable) Hardware Compression for the local group. This enables SRDF hardware data compression on an SRDF group defined on a GigE director. Although you can enable/disable hardware compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or higher.

f. Select a Remote Link Limbo Period. This is a length of time for the storage system to continue checking the remote SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.

g. Select (enable) Remote Link Domino for the remote group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) volumes is always in synch.

h. Select (enable) Remote Auto Link Recovery for the remote group. With this feature enabled, once the link failure is corrected, volumes that were
ready to their host before the failure will automatically be restored to the ready state.

i. Click OK.

Modifying SRDF groups

Before you begin
SRDF requires Enginuity version 5773 - 5876, or HYPERMAX OS 5977 or higher.

To modify SRDF groups:

Procedure
1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF groups to open the SRDF groups list view.
3. Select a group and click Edit to open the Edit SRDF group dialog box.
4. Do any number of the following steps:
   a. Select a new local Director through which the group will communicate. When specifying a local or remote director for a VMAX system running HYPERMAX OS 5977, you can select one or more SRDF ports.
   b. Select a new Remote Director through which the group will communicate.
   c. Select a Link Limbo Period. The length of time for the VMAX system to continue checking the local SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.
   d. Select (enable) Link Domino for the local group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) devices is always in synch.
   e. Select (enable) Auto Link Recovery for the local group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.
   f. Select (enable) Software Compression for the local group. This enables SRDF software data compression for SRDF groups defined on GigE, or Fibre Channel. Although you can enable/disable software compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or later.
   g. Select (enable) Hardware Compression for the local group. This enables SRDF hardware data compression on an SRDF group defined on a GigE director. Although you can enable/disable hardware compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or later.
   h. Select a Remote Link Limbo Period. This is a length of time for the VMAX system to continue checking the remote SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.
   i. Select (enable) Remote Link Domino for the remote group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in
the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) volumes is always in synch.

j. Select (enable) **Remote Auto Link Recovery** for the remote group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.

5. Click **OK**.

### Setting SRDF/A DSE attributes

**Procedure**

1. Select a storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF groups**.
3. Select a group, click more **>>**, and select **SRDF/A DSE**.
4. Select the pool. For systems running HYPERMAX OS 5977, this option may not be available.
5. Type the percentage of the storage system’s write pending limit (**Threshold**). Once the cache usage of all active groups in the storage system exceeds this limit, data tracks for this group start to spill over to disks. Possible values are from 20 to 100, with 50 being the default.
6. (Optional) Select (enable) the SRDF/A write pacing feature to automatically start for the group when an SRDF/A session is activated (**Autostart**). This feature must be activated for host write I/O pacing to be invoked. For systems running HYPERMAX OS 5977, **Autostart** is always enabled.
7. Manually **Activate/Deactivate** the SRDF/A Delta Set Extension (DSE) feature. DSE allows SRDF/A cache to be extended by offloading some or all of the session cycle data to preconfigured disks or pools. Possible values are:
   - **No change**—Leaves the current write pacing setting.
   - **Activate**—Activates the feature for the local side of the SRDF link.
   - **Activate Both Sides**—Activates the feature for both sides of the SRDF link.
   - **Deactivate**—Deactivates the feature for the local side of the SRDF link.
   - **Deactivate Both Sides**—Deactivates the feature for both sides of the SRDF link.
   Starting with Enginuity 5773.150, this feature is supported with thin devices.
8. Click **OK**.

### Setting SRDF/A pace attributes

**Procedure**

1. Select a storage system.
2. Select **Data Protection > Replication Groups and Pools > SRDF groups**.
3. Select a group, click more **>>**, and select **SRDF/A Pace**.
4. Type the maximum I/O delay to apply to each host write I/O when the pacing algorithm is invoked (**Pacing Delay**). Possible values range from 1 to 1,000,000...
usec (0.000001 to 1 second), with 50,000 (0.05 seconds or 50 ms) being the default.

5. Type the minimum cache percentage when host write pacing will start (Threshold). Possible values range from 1 to 99, with 60% being the default.

6. (Optional) Select to set the threshold on both the R1 and R2 sides (Both Sides).

7. (Optional) Set the following write pacing attributes for the RDF group, the volumes in the group, or both:
   a. Select (enable) the SRDF/A write pacing feature to automatically start when an SRDF/A session is activated (Autostart). This feature must be activated for host write I/O pacing to be invoked.
   b. Manually Activate/Deactivate the SRDF/A write pacing feature for the RDF group. Setting this option to No Change leaves the current write pacing setting.

SRDF/A write pacing can only be activated when the SRDF/A session is active.

8. Click OK.

**Swapping SRDF groups**

When you swap the SRDF personality of the designated SRDF volumes, the source (R1) volumes become target (R2) volumes and the target (R2) volumes become source (R1) volumes.

**Before you begin**

Before you begin:

- If the target (R2) volume is on a storage system running HYPERMAX OS 5977 or later, and the mode of the source (R1) volume is Adaptive Copy Write Pending, SRDF will set the mode to Adaptive Copy Disk.
- As a result of a swap, or half swap, operation, a cascaded R1 -> R21 -> R2 configuration can be created if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.

**To swap SRDF groups:**

**Procedure**

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF Groups.
3. Select an SRDF group, click more, and select Swap to open the Swap SRDF group dialog box.
4. Select the mirror to refresh.
5. (Optional) Indicate if a half swap is required.
6. Select to Start refreshing the selected mirror (Start Copy).
7. If the RDF group you are swapping is part of an SRDF/Star configuration, select Star.
8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
• Expand Add to Job List, and click Run Now to perform the operation now.

Enabling consistency protection

This procedure explains how to enable consistency protection for a device group consisting of SRDF/A volumes.

Procedure

1. Select the storage system.
2. Select Data Protection > Remote Replication and expand the Device Groups folder.
3. Select a group, click more, and select Enable to open the Enable Device Group dialog box.
4. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
5. Do one of the following:
   • Click OK to start the operation now.
   • Click Show Advanced to set the advanced session options. Select the advanced options and click OK.

Disabling consistency protection

This procedure explains how to disable consistency protection for a device group consisting of SRDF/A volumes

Procedure

1. Select the storage system.
2. Select Data Protection > Remote Replication and expand the Device Groups folder.
3. Select a group, click more, and select Disable.
4. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
5. Do one of the following:
   • Click OK to start the operation now.
   • Click Show Advanced to set the advanced SRDF session options. Select the advanced options and click OK.

Deleting SRDF groups

Before you begin:

To delete SRDF groups:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups & Pools > SRDF groups.
3. Select the SRDF group, click more, and select Delete.
4. Optional: Click Show Advanced and select the Use Force check box.
This forces the operation.

5. Optional: Click **Show Advanced >>** and select the **Use SymForce** check box.
   This forces the operation when the operation would normally be rejected.

6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Viewing SRDF groups

**Procedure**

1. Select the storage system.

2. Select **Data Protection > Replication Groups and Pools > SRDF groups** to open the **SRDF groups** list view.

   Use the **SRDF groups** list view to display and manage SRDF groups.

   The following properties display:

   - **SRDF Group**—SRDF group number.
   - **SRDF Group Label**—SRDF group label, for example, Async, Metro, Witness.
   - **Remote SRDF group**—Remote RDF group number.
   - **Remote Symmetrix**—Remote storage system serial ID. This field is only displayed when the SRDF pair state is Partitioned.
   - **Type**—Type of group, for example, Dynamic or Witness.
   - **SRDF Modes**—SRDF modes associated with the SRDF group.
   - **SRDF group Flags**—SRDF group flags. This field only applies/appears for Symmetrix systems running Enginuity 5773 or 5876.
   - **Volume Count**—Number of volumes in the group.
   - **Copy Jobs**—Maximum number of RDF copy jobs per RDF group.
   - **Link Limbo (sec)**—Number of seconds (0-10) for the VMAX system to continue checking the local RDF link status.
   - **CSRMTDA**—See **RDFA flags** on page 582.
   - **Minimum Cycle**—Minimum time to wait before attempting an SRDF/A cycle switch. Values range from 5 to 59 seconds.
   - **Session Priority**—Priority used to determine which SRDF/A sessions to drop if cache becomes full. Values range from 1 to 64, with 1 being the highest priority (last to be dropped).
   - **Transmit Idle**—Time the transmit cycle has been idle.

   The following controls are available:

   - **Create Group**—Creating SRDF groups on page 567
   - **Create Pairs**—Creating SRDF pairs on page 511
   - **Edit**—Modifying SRDF groups on page 569
   - **View Details**—Viewing SRDF group details on page 574
   - **Create SRDF Connection**—Creating SRDF connections on page 511
Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 234
SRDF/A DSE Setting—Setting SRDF/A DSE attributes on page 570
SRDF/A Setting—Setting SRDF/A group attributes on page 564
SRDF/A Pacing Setting—Setting SRDF/A pace attributes on page 570
Swap Groups—Swapping SRDF groups on page 571
Delete—Deleting SRDF groups on page 572

Viewing SRDF group details

To view SRDF group details:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF groups to open the SRDF groups list view.
3. Select the SRDF group and click View Details to open its Details view.
4. Use the SRDF Group Detail view to view the properties of an SRDF group. This view contains two panels, Properties and Related Objects.

The properties listed depend on the specifics of the storage system. Some or all of the following properties display:

- **SRDF Group Number**—SRDF group number.
- **SRDF Group Label**—SRDF group label.
- **SRDF Director number(s)**—SRDF director numbers.
- **Director Identity**—Director identifier(s).
- **Remote SRDF Group number(s)**—Remote group number(s).
- **Remote Symmetrix**—Remote storage system serial ID(s).
- **Remote SRDF director number(s)**—Remote SRDF director numbers.
- **Remote Director Identity**—Remote director identifier(s).
- **SRDF Modes**—SRDF Modes. Possible values are: N/A, Adaptive Copy, Synchronous, Asynchronous, Active.
- **SRDF/Metro**—SRDF/Metro. Possible values are: Yes, No.
- **SRDF/Metro Witness Degraded**—SRDF/Metro Witness Degraded. Possible values are: Yes, No.
- **SRDF Group Flags**—SRDF group flags. This field only applies/appears for storage systems running Enginuity 5773 or 5876.
- **Prevent Auto Link Recovery**—Indicates the state of preventing automatic data copy across SRDF links upon recovery.
- **Copy Jobs**—Maximum number of SRDF copy jobs per SRDF group.
- **Prevent RAs Online Upon Power On**—Indicates the state of preventing the SRDF directors from automatically coming back online with power on.
- **Link Domino**—Sets the domino mode for the source (R1) volumes.
- **Link Config**—Link configuration.
- **Director Config**—Indicates the Fibre adapter type.
SRDF Group Configuration—RA group configuration. Possible values are: Dynamic, Static, Witness.

Link Limbo (sec)—Number of seconds (0-10) for the storage system to continue checking the local SRDF link status.

Minimum Cycle Time—Minimum cycle time (seconds) configured for this session.

Duration of last transmit cycle—Duration of the last transmit cycle.

Transmit Queue Depth on R1 side—Depth of the transmit queue on the source side.

Transmit Idle Time—Time the transmit cycle has been idle.

Transmit Idle—Whether SRDF/A Transmit Idle state is active for the SRDF group.

R1 Side Percent Cache in Use—Percent of system write pending cache slots used by the R1 side.

R2 Side Percent Cache in Use—Percent of system write pending cache slots used by the R2 side.

Dynamic Cache Partition Name—Cache partition name.

SRDF/A Mode—The SRDF/A mode. The status of the property can be Single-session, MSC, or N/A.

MSC Cleanup Required—Indicates if MSC cleanup is required. The status of the property can be Yes, No, or N/A.

SRDF/A Session Status—The SRDF/A session status. The status of the property can be Active, Inactive, or N/A.

SRDF/A Consistency Protection—Indicates if consistency protection is enabled. The status of the property can be Enabled, Disabled, or N/A.

SRDF/A DSE Status—Indicates if SRDF/A DSE is active.

SRDF/A DSE Autostart—Indicates if SRDF/A DSE is automatically enabled when an SRDF/A session is activated for the group.

SRDF/A DSE Threshold—Percentage of the storage systems write pending limit.

SRDF/A Write Pacing Status—Indicates if SRDF/A write pacing is active.

SRDF/A Contains Pace Capable Volumes—Indicates if group contains write pacing capable volumes.

SRDF/A Write Pacing Delay—Max delay allowed for host I/O in seconds.

SRDF/A Write Pacing Threshold—Minimum cache percentage when host write pacing will start.

SRDF/A Write Pacing Autostart—Indicates if the SRDF/A write pacing feature is automatically activated when an SRDF/A session is activated.

SRDF/A Write Pacing Supported—Indicates if SRDF/A write pacing is supported.

Device Pacing Supported—Indicates if SRDF/A device pacing is supported.

Group Level Pacing State—Indicates if group level write pacing is enabled or disabled.

Device Pacing Activated—Group-level pacing status of the SRDF/A session. The status of the feature can be Active, Inactive, N/A.
Group Pacing Auto Start—Indicates if group pacing auto start is enabled/disabled on the SRDF group.

Device Pacing Auto Start—Indicates if device pacing auto start is enabled/disabled on the SRDF group.

SRDF Software Compression—Indicates if software compression is enabled/disabled on the SRDF group.

SRDF Single Round Trip—Indicates if single round trip is enabled/disabled on the SRDF group.

SRDF Hardware Compression—Indicates if hardware compression is enabled/disabled on the SRDF group.

SRDF Software Compression Support—Indicates if SRDF software compression is enabled or disabled.

SRDF Group Software Compression—Indicates if SRDF software compression is enabled or disabled for the SRDF group.

SRDF Hardware Compression Support—Indicates if SRDF hardware compression is supported on the storage system.

SRDF Group Hardware Compression—Indicates if SRDF hardware compression is enabled or disabled for the SRDF group.

Star Mode—Indicates if SRDF group is in a star configuration.

SQAR Mode—Indicates if SRDF group is in a SQAR configuration.

Related Objects panel

The Related Objects panel provides links to views for objects contained in and associated with the SRDF group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Volumes -2 will open a view listing the two volumes contained in the SRDF group.

---

**Viewing SRDF protected device groups**

The SRDF dashboard provides you with a single place to monitor and manage SRDF sessions on a storage system. This includes device groups types R1, R2, and R21. See Managing remote replication sessions on page 510 for additional information.

Before you begin:

SRDF requires Enginuity version 5773, 5876, or HYPERMAX OS 5977.

The following configurations are not supported:

- An R21 or R22 SRDF device on a system running HYPERMAX OS 5977.
- A cascaded SRDF configuration containing a system running HYPERMAX OS 5977.
- A concurrent R22 configuration containing a system running HYPERMAX OS 5977.

To access the SRDF dashboard:

**Procedure**

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Device Groups.
   
   The following properties display:

   SRDF dashboard:
- **Source Group**—Device group name.
- **Standard**—Number of standard volumes.
- **BCV**—Number of BCV volumes.
- **State**—Current state of device group.
- **Group Type**—Device group type.
- **Group Valid**—Indicates if the group is valid or invalid for SRDF management.

The following controls are available:
- **Establish**—Establishing SRDF pairs on page 536
- **Split**—Splitting SRDF pairs on page 550
- **Suspend**—Suspending SRDF pairs on page 551
- **Restore**—Restoring SRDF pairs on page 547
- **View Storage Groups**—Viewing storage groups (Enginuity 5876) on page 145
- **View Details**—Viewing SRDF volume pairs on page 518
- **Resume**—Resuming SRDF links on page 543
- **Failover**—Failing over on page 537
- **Failback**—Failing back on page 538
- **Swap**—Swapping SRDF personalities on page 552
- **Enable Consistency**—Enabling consistency protection on page 572
- **Disable Consistency**—Disabling consistency protection on page 572
- **Delete Pair**—Deleting SRDF pairs on page 514
- **Move**—Moving SRDF pairs on page 516
- **Activate SRDF/A**—Activating SRDF/A controls to prevent cache overflow on page 532
- **Deactivate SRDF/A**—Deactivating SRDF/A controls on page 533
- **Invalidate**—Invalidating R1/R2 volumes on page 539
- **Ready**—Making R1/R2 volumes ready on page 540
- **Not Ready**—Making R1/R2 volumes not ready on page 541
- **R1 Update**—Updating R1 volumes on page 552
- **RW Enable**—Read/write enabling R1/R2 volumes on page 542
- **Write Disable**—Read/write disabling R1/R2 volumes on page 544
- **RW Disable R2s**—Read/write disabling R2 volumes on page 542
- **Refresh**—Refreshing R1 or R2 volumes on page 545
- **Set Mode**—Setting SRDF mode on page 516

---

**Viewing SRDF/Metro protected storage groups**

Unisphere for VMAX 8.1 and later provides SRDF monitoring and management for SRDF/Metro protected storage groups. Only single hop SRDF is supported for SRDF/Metro, that is, current or cascaded setups are not supported. See [Managing remote replication sessions](#) on page 510 for additional information.
Procedure

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click SRDF/Metro to open the SRDF/Metro storage group list view.

The following properties display, depending on the operating environment:

- **Storage Group** — User-defined storage group name.
- **Capacity (GB)** — Total capacity of the storage group in GB.
- **State** — The state of the storage group. Possible values are:
  - Active Active
  - Consistent
  - Failed Over
  - Invalid
  - Partitioned
  - R1 Updated
  - R1 Update in progress
  - Suspended
  - Synchronization in progress
  - Synchronized
  - Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

- **SRDF Mode** — The SRDF copy type.
- **Local Bias** — Bias refers to the side (R1 or R2) of the SRDF group that should remain ready (RW) to the host(s) if the link becomes Not Ready (NR). The non-bias side is made NR to the host(s) in this case.
- **SRDF Group** — The SRDF group number.
- **Masking Views** — The name of the masking group.
- **Emulation** — The emulation type (ALL, FBA, CKD).

The following controls are available, depending on the operating environment:

- **Establish** — Establishing SRDF pairs on page 536
- **Suspend** — Suspending SRDF pairs on page 551
- **Restore** — Restoring SRDF pairs on page 547
- **View Storage Groups** — Viewing storage group details (HYPERMAX OS 5977 or later) on page 140
- **View Details** — Viewing SRDF/Metro protected storage group pairs on page 525
- **Set Bias** — Setting bias location on page 548
- **Delete Pair** — Deleting SRDF pairs on page 514
Enabling device groups

This procedure explains how to enable consistency protection for a device group consisting of SRDF/A volumes.

Procedure

1. Select the storage system.
2. Select Data Protection > Remote Replication and expand the Device Groups folder.
3. Select a group, click more, and select Enable.
4. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
5. Click one of the following:
   - OK to start the operation now.
   - Show Advanced to set the advanced SRDF session options. Select the advanced options and click OK.

Resuming SRDF links

This procedure explains how to resume I/O traffic on the SRDF links for all remotely mirrored RDF pairs in a group.

Procedure

1. Select the storage system.
2. Select Data Protection > Remote Replication and expand the Device Groups folder.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click more, and select Resume to open the Resume dialog box.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
     c. Do one of the following:
        - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
        - Expand Add to Job List, and click Run Now to perform the operation now.
        - Click Show Advanced to set the advanced SRDF session options. Select the advanced options and click OK.
   - Pair level:
     a. Select a group and click View Details to open the SRDF pair list view.
     b. Select one or more pairs, click more, and select Resume to open the Resume dialog box.
c. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
- Click **Show Advanced** to set the advanced SRDF session options. Select the advanced options and click **OK**.

**Select local start volume dialog**

Use this dialog box to select the first volume in the range of volumes on the local storage system. Not in PDF

The following properties are displayed:

- **Start Volume**—Volume ID.
- **Volume Config**—Volume configuration.
- **Capacity (GB)**—Volume capacity in GB.
- **Emulation**—Volume emulation.
- **Group**—SRDF group containing the volume.
- **BCV Associations**—Number of BCVs associated with the volume.
- **Capacity (Cylinder)**—Volume capacity in cylinders.
- **GCM**—Whether the Geometry Compatible Mode (GCM) attribute is set on the volume. GCM modifies how a storage system running HYPERMAX OS 5997 or later manages the size of a volume. When the GCM attribute is set, the volume is treated as ½ a cylinder smaller than its true configured size. This enables a volume on a storage system running HYPERMAX OS 5977 to be paired with a volume on an storage system running Enginuity 5876, when the 5876 volume has an odd number of cylinders.

**Select remote start volume dialog**

Use this dialog box to select the first volume in the range of volumes on the remote storage system.

The following properties are displayed:

- **Start Volume**—Volume ID.
- **Volume Config**—Volume configuration.
- **Capacity (GB)**—Volume capacity in GB.
- **Emulation**—Volume emulation.
- **Group**—SRDF group containing the volume.
- **BCV Associations**—Number of BCVs associated with the volume.
- **Capacity (Cylinder)**—Volume capacity in cylinders.
- **GCM**—Whether the Geometry Compatible Mode (GCM) attribute is set on the volume. GCM modifies how a storage system running HYPERMAX OS 5997 or later manages the size of a volume. When the GCM attribute is set, the volume is treated as ½ a cylinder smaller than its true configured size. This enables a volume on a storage system running HYPERMAX OS 5977 to be paired with a volume on
Viewing SRDF group volumes

This procedure explains how to view the volumes in an SRDF group:

Procedure

1. Select the storage system.
2. Select Data Protection > Replication Groups and Pools > SRDF groups to open the SRDF groups list view.
3. Select the SRDF group and click View Details to open its Details view.
4. In the Related Objects panel, click SRDF Group Volumes to open the SRDF List Volumes view.

The following properties display:

Volumes—Local volume ID.
Configuration—SRDF configuration.
Remote Symmetrix—Remote storage system ID.
Remote SRDF Group—Remote SRDF group ID.
Target Volume—Target volume ID.
State—Session state of the pair
Pair State—Volume pair state.
Remote Volume State—State of the remote volume.
SRDF Mode—SRDF copy type.

SRDF/A control actions

<table>
<thead>
<tr>
<th>Action</th>
<th>Activate Type</th>
<th>Write Pacing Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate</td>
<td>DSE</td>
<td>N/A</td>
<td>Activates the SRDF/A Delta Set Extension feature, which extends the available cache space by using device SAVE pools.</td>
</tr>
<tr>
<td>Write Pacing</td>
<td></td>
<td></td>
<td>Group write pacing is supported on Symmetrix systems running Enginuity 5876 and higher. Activates SRDF/A write pacing at the group level.</td>
</tr>
</tbody>
</table>

This feature extends the availability of SRDF/A by preventing conditions that result in cache overflow on both the R1 and R2 sides.
### Action

<table>
<thead>
<tr>
<th>Action</th>
<th>Activate Type</th>
<th>Write Pacing Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group &amp; Volume Write Pacing</td>
<td></td>
<td>Activates SRDF/A write pacing at the group level and the volume level</td>
<td></td>
</tr>
<tr>
<td>Volume Write Pacing</td>
<td></td>
<td>Activates SRDF/A write pacing at the volume level</td>
<td></td>
</tr>
<tr>
<td>Write Pacing Exempt</td>
<td>N/A</td>
<td>Activates write pacing exempt. Write pacing exempt allows you to remove a volume from write pacing</td>
<td></td>
</tr>
</tbody>
</table>

### RDFA flags

<table>
<thead>
<tr>
<th>Flag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C)onsistency</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(S)tatus</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>(R)DFA Mode</td>
<td>S = Single-session, M = MSC, - = N/A</td>
</tr>
<tr>
<td>(M)sc Cleanup</td>
<td>C = MSC Cleanup required, - = N/A</td>
</tr>
<tr>
<td>(T)ransmit Idle</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(D)SE Status</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>DSE (A)utostart</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
</tbody>
</table>

### SRDF group modes

The following values can be set for SRDF groups:

**Synchronous**—Provides the host access to the source (R1) volume on a write operation only after the VMAX system containing the target (R2) volume acknowledges that it has received and checked the data.

**Asynchronous**—The VMAX system acknowledges all writes to the source (R1) volumes as if they were local volumes. Host writes accumulate on the source (R1) side.
until the cycle time is reached and are then transferred to the target (R2) volume in one delta set. Write operations to the target volume can be confirmed when the current SRDF/A cycle commits the data to disk by successfully de-staging it to the R2 storage volumes.

For storage systems running Enginuity 5876, you can put an RDF relationship into Asynchronous mode when the R2 volume is a snap source volume.

**Semi Synchronous**—The VMAX system containing the source (R1) volume informs the host of successful completion of the write operation when it receives the data. The RDF (RA) director transfers each write to the target (R2) volume as the RDF links become available. The VMAX system containing the target (R2) volume checks and acknowledges receipt of each write.

**AC WP Mode On**—(adaptive copy write pending) the VMAX system acknowledges all writes to the source (R1) volume as if it was a local volume. The new data accumulates in cache until it is successfully written to the source (R1) volume and the remote director has transferred the write to the target (R2) volume.

**AC Disk Mode On**—For situations requiring the transfer of large amounts of data without loss of performance; use this mode to temporarily transfer the bulk of your data to target (R2) volumes; then switch to synchronous or semi-synchronous mode.

**Domino Mode On**—Ensures that the data on the source (R1) and target (R2) volumes are always in sync. The VMAX system forces the source (R1) volume to a Not Ready state to the host whenever it detects one side in a remotely mirrored pair is unavailable.

**Domino Mode Off**—The remotely mirrored volume continues processing I/Os with its host, even when an SRDF volume or link failure occurs.

**AC Mode Off**—Turns off the AC disk mode.

**AC Change Skew**—Modifies the adaptive copy skew threshold. When the skew threshold is exceeded, the remotely mirrored pair operates in the predetermined SRDF state (synchronous or semi-synchronous). As soon as the number of invalid tracks drop below this value, the remotely mirrored pair reverts back to the adaptive copy mode.

**R2 NR If Invalid** On—Sets the R2 device to Not Ready if there are invalid tracks.

**R2 NR If Invalid** Of—Turns off the (R2 NR_If_Invalid) On mode.

---

**Understanding RecoverPoint**

RecoverPoint provides block-level continuous data protection and continuous remote replication for on-demand protection and recovery at any point-in-time, and enables you to implement a single, unified solution to protect and/or replicate data across heterogeneous servers and storage.

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the Symmetrix system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

---

**Tagging and untagging volumes for Recoverpoint (storage group level)**

**Before you begin**

- Volumes that are part of an RDF pair cannot be tagged for RecoverPoint.
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the Symmetrix system.
This feature is not supported on storage systems running HYPERMAX OS 5977.

This procedure explains how to tag (enable) or untag (disable) volumes for Recoverpoint. Enabling volumes makes them accessible to the RecoverPoint appliance.

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Do one of the following:
   - To tag the storage group, select it, click , and select Tag for RecoverPoint.
   - To untag the storage group, select it, click , and select Untag for RecoverPoint.
4. Click OK in the confirmation message.

**Tagging and untagging volumes for Recoverpoint (volume level)**

**Before you begin**

- Volumes that are part of an RDF pair cannot be tagged for RecoverPoint.
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the Symmetrix system.
- This feature is not supported on storage systems running HYPERMAX OS 5977.

This procedure explains how to tag (enable) or untag (disable) volumes for Recoverpoint. Enabling volumes makes them accessible to the RecoverPoint appliance.

**Procedure**

1. Select the storage system.
2. Select Storage > Volumes.
3. In the All Volumes panel, expand the type of volume to tag or untag.
4. Do one of the following:
   - To tag volumes, select volumes, click , and select Tag for RecoverPoint.
   - To untag volumes, select volumes, click , and select Untag for RecoverPoint.
5. Click OK in the confirmation message.

**Untagging RecoverPoint tagged volumes**

**Before you begin**

This feature is not supported on storage systems running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Open Replicator > RecoverPoint Volumes.
   
   Opens the RecoverPoint Volumes view.
3. Single or multi-select (hold shift key and select) volumes and click Untag for RecoverPoint.

4. Click OK in the confirmation message.

**Viewing RecoverPoint copies**

**Before you begin**
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint copies for a particular consistency group.

**Procedure**

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
   - Opens the RecoverPoint view.
3. Select a RecoverPoint system and click View Details.
   - Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click Copies.
   - Opens the Copies list view which lists the consistency groups on the selected RecoverPoint system.
   - The following properties display:
     - **Name**—Name of copy.
     - **State**—State of the copy. Valid values are Enabled or Suspended.
     - **Copy Size**—Size of the copy.
     - **Copy Role**—Current role of the copy. Valid values are Active or Replica.
     - **RTO**—Recovery time objective
     - **Journal State**—Indicates the state of the journal. Valid values include Locked and Distributing.
     - **Journal Size**—Size of the journal, in GB.

   The following controls are available:
   - **View Details**—Viewing RecoverPoint copy details on page 585

**Viewing RecoverPoint copy details**

**Before you begin**
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

**Procedure**

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
Opens the RecoverPoint view.

3. Select a RecoverPoint system and click View Details.

Opens the Consistency Group list view.

4. Select a RecoverPoint consistency group and click Copies.

Opens the Copies list view.

5. Select a copy and click View Details.

Opens the copy's details view.

The following properties display:

- **Name**—Name of copy.
- **State**—State of the copy. Valid values are *Enabled* or *Suspended*.
- **Role**—Current role of the copy. Valid values are *Active* or *Replica*.
- **Copy Size**—Size of the copy.
- **Journal Size**—Size of the journal, in GB.
- **Journal State**—Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
- **Journal Volume Name**—Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
- **Cluster**—Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
- **RTO (seconds)**—Recovery time objective in seconds
- **Journal Size Limit**—Journal size limit
- **AllowDistribOfLargeSnaps**—Allow distribution of large snapshots
- **AllowSymmWithOneRPA**—Allow storage system with one RPA
- **ActivePrimaryRPA**—Active primary RPA
- **FastForwardBound**—Fast forward bound
- **NumCopySplitters**—Number of copy splitters
- **NumCopyVolumes**—Number of copy volumes
- **NumJournalVolumes**—Number of journal volumes
- **PhoenixDevices**—Phoenix devices
- **TspWritesCleared**—Tsp writes cleared
- **UserSnapshot**—User snapshot
- **Production Copy**—Production copy.
- **Volumes**—Number of associated volumes.
- **Copy Capacity (GB)**—Capacity of the copy, in GB.

### Viewing RecoverPoint sessions

**Procedure**

1. Select a storage system.
2. Select **Data Protection > OpenReplicator > RecoverPoint Sessions** to open the RecoverPoint Sessions list view.
3. Use the RecoverPoint Sessions list view to view RecoverPoint sessions on the storage system.
The following properties display:

- **Cluster name** — Session name.
- **Control volume** — Control volume name.
- **Status** — Session status.
- **Protected Tracks** — Number of protected tracks.

The following controls are available:

- **View Details** — Viewing RecoverPoint session details on page 587

### Viewing RecoverPoint session details

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **RecoverPoint Sessions**.
   
   Opens the **RecoverPoint Sessions** list view.
3. Select a session and click **View Details**.
   
   Opens the session details view.

   The following properties display:

   - **Cluster Name** — Session Name.
   - **Control Volume** — Control volume name.
   - **Remote Volume Specification** — Indicates the remote volume name format.
   - **Status** — Session status.
   - **Copy pace** — Copy pace value.
   - **Protected Tracks** — Number of protected tracks.

### Viewing RecoverPoint storage groups

**Before you begin**

RecoverPoint operations on Unisphere for VMAX require 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To perform this operation, you must be a monitor or higher.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Replication Groups and Pools** > **RecoverPoint Systems**.
3. Select a RecoverPoint system and click **View Details** to open the **Consistency Group** list view.
4. Select a RecoverPoint consistency group and click **Copies** to open the **Copies** list view.
5. Select a copy and click **View Details** to open the details view.
6. In the **Related Objects** panel, click **Storage Groups**.
The following information displays:

- **Name**—Name of the storage group.
- **Volumes**—Number of volumes in the group.
- **Masking views**—Number of associated masking views.
- **FAST_Policy**—FAST policy associated with the RecoverPoint storage group.
- **Capacity**—Capacity of the storage group.
- **Child SG**—For parent storage groups, this field displays the number of child storage groups; otherwise, this field displays zero.

### Viewing RecoverPoint tagged volumes

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Recover Point Volumes** to open the **RecoverPoint Volumes list view**.

   The following properties display:
   - **Name**—Volume name.
   - **Type**—Volume volume.
   - **Status**—Volume status.
   - **Reserved**—Indicates if volume is reserved.
   - **Capacity (GB)**—Volume capacity in GB.
   - **Emulation**—Volume emulation type.

   The following controls are available:
   - **View Details**—Viewing RecoverPoint tagged volume details on page 588
   - **Untag for RecoverPoint**—Tagging and untagging volumes for Recoverpoint (volume level) on page 584

### Viewing RecoverPoint tagged volume details

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Recover Point Volumes**.
3. Select the volume and click **View Details** to open its Details view.

   This view allows you to view the volume details.
   - The following properties display:
     - **Name**—Volume name.
     - **Physical Name**—Physical name.
     - **Volume Identifier**—Volume identifier.
     - **Type**—Volume configuration.
     - **Encapsulated Volume**—Whether the volumes is encapsulated. Relevant for external disks only.
     - **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
Status—Volume status.
Reserved—Whether the volume is reserved.
Capacity (GB)—Volume capacity in GBs.
Capacity (MB)—Volume capacity in MBs.
Capacity (Cylinders)—Volume capacity in cylinders.
Emulation—Volume emulation.
Symmetrix ID—Storage system on which the volume resides.
Symmetrix Volume ID—Storage volume name/number.

HP Identifier Name—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.

VMS Identifier Name—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

Nice Name—Nice name generated by Symmetrix Enginuity.

WWN—World Wide Name of the volume.
DG Name—Name of the device group in which the volume resides, if applicable.

CG Name—Name of the device group in which the volume resides, if applicable.

Attached BCV—Defines the attached BCV to be paired with the standard volume.

Attached VDEV TGT Volume—Volume to which this source volume would be paired.

RDF Type—RDF configuration.

Geometry - Type—Method used to define the volume's geometry.

Geometry - Number of Cylinders—Number of cylinders, as defined by the volume's geometry.

Geometry - Sectors per Track—Number of sectors per track, as defined by the volume's geometry.

Geometry - Tracks per Cylinder—Number of tracks per cylinder, as defined by the volume's geometry.

Geometry - 512 Block Bytes—Number of 512 blocks, as defined by the volume's geometry.

Geometry Capacity (GB)—Geometry capacity in GBs.

Geometry Limited—Indicates whether an encapsulated volume has a Symmetrix cylinder size larger than the reported user-defined geometry.

SSID—Subsystem ID.

Capacity (Tracks)—Capacity in tracks.

SA Status—Volume SA status.

Host Access Mode—Host access mode.

Pinned—Whether the volume is pinned.

RecoverPoint Tagged—Whether or not the volume is tagged for RecoverPoint.

Service State—Service state.
Defined Label Type—Type of user-defined label.

Dynamic RDF Capability—RDF capability of the volume.

Mirror Set Type—Mirror set for the volume and the volume characteristic of the mirror.

Mirror Set DA Status—Volume status information for each member in the mirror set.

Mirror Set Invalid Tracks—Number of invalid tracks for each mirror in the mirror set.

Priority QoS—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

Dynamic Cache Partition Name—Name of the cache partition.

XtremSW Cache Attached—Whether the volume is currently controlled by cache cards.

Compressed Size (GB)—Size of the compressed volume.

Compressed Ratio (%)—Percentage of volume compressed.

Compressed Size Per Pool (GB)—Size of the compressed pool.

Optimized Read Miss—Cacheless readmiss status. Possible values are:

Off—Feature is disabled.

System Managed—The storage system determines the appropriate optimized read miss mode.

The following control is available:

Untag for RecoverPoint—Tagging and untagging volumes for Recoverpoint (volume level) on page 584

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**Protecting storage groups using RecoverPoint**

**Before you begin**

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation you must be a StorageAdmin.
- The storage group being replicated must be masked to the host.
- The storage group being replicated must not contain any volumes that are already tagged for RecoverPoint.
- Connectivity to the RecoverPoint system/cluster is available.
- RecoverPoint 4.1 is setup and operational. For each cluster in the setup, gatekeepers and repository volumes must be configured in their relevant masking view. uses a default journal masking view naming convention.
- Depending on the options selected as part of the Protect Storage Group wizard and the existing configuration, some values for some options might populate automatically.

**Procedure**

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select the storage group and click **Protect**.

4. On the **Select Protection Type** page, select **Continuous Protection > Using RecoverPoint**.

5. Click **Next**.

6. On the **Group Production Settings** page, specify the following information:
   - **RecoverPoint System**—RecoverPoint system.
   - **RecoverPoint Group Name**—Name of the RecoverPoint group.
   - **RecoverPoint Cluster**—RecoverPoint cluster.
   - **Production Name**—Name of the production.
   - **Journal Thin Pool**—Journal thin pool.
   - **Journal Port Group**—Journal port group.

7. Click **Next**.

8. On the **Add Copies** page, specify the following information:
   - **RecoverPoint Cluster**—RecoverPoint cluster.
   - **Copy Name**—Name of the RecoverPoint copy.
   - **Mode**—Specify whether the mode is Synchronous or Asynchronous.
   - **Symmetrix**—Storage system.
   - **Target Storage Group**—Specify whether the RecoverPoint copy targets a new storage group or an existing group.

9. Click **Add Copy**.
   - Lists the copy in the **Copy Summary** table.

10. Click **Next**.

11. On the **Finish** page, verify your selections. To change any of them, click **Back**. Some changes may require you to make additional changes to your configuration.

12. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
   - Expand **Add to Job List**, then click **Run Now** to perform the operation now.

### Viewing RecoverPoint volumes

**Before you begin**

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint volumes for a particular consistency group.

To view RecoverPoint volumes:

**Procedure**

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
3. Select a RecoverPoint system and click View Details.
4. Select a RecoverPoint consistency group and click View Details.
5. In the Related Objects panel, click Replication Sets.
6. Select the replication set and click View Details.
7. In the Related Objects panel, click Volumes.

The following properties display:
- Volume Name—Name of the volume.
- Volume Capacity (GB)—Capacity, in GB, of the volume.
- Replication Set—RecoverPoint replication set.
- Copy Name—RecoverPoint copy.
- Storage Type—Type of storage system.
- Array Serial Number—Serial number.
- Vendor—Vendor of the volume.
- Product Name—Storage product installed.
- Product Model—Model of storage system.

**Viewing RecoverPoint clusters**

**Before you begin**

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Data Replication and Pools > Recover Point Systems.
   
   Opens the RecoverPoint Systems list view.
3. Select a RecoverPoint system.
4. Select View Details.

   Opens the RecoverPoint Clusters table view.

   The following information displays:
   - RPA Cluster Name—Name of the cluster.
   - RPAs—Number of RecoverPoint appliances.
   - Management IPv4—IP address, in IPv4 format. If an IPv6 address is used, this column has the value "N/A".
   - Management IPv6—IP address, in IPv6 format. If an IPv4 address is used, this column has the value "N/A".
   - RPA Type—RecoverPoint appliance type.
   - Maintenance Mode—Maintenance mode in use.
Viewing RecoverPoint cluster details

Procedure

1. Select the storage system.
2. Select Data Protection > Data Replication and Pools > Recover Point Systems.

   Opens the RecoverPoint Systems list view.
3. Select a system and click View Details.

   Opens the cluster list view.
4. Select a cluster and click View Details.

   Opens the cluster details view.

   The following properties display:
   - Cluster Name—Volume name.
   - Management IPv4—IP address, in IPv4 format. If an IPv6 address is used, this column has the value "N/A".
   - Management IPv6—IP address, in IPv6 format. If an IPv4 address is used, this column has the value "N/A".
   - Software Serial ID—Serial ID of the software.
   - RPAs—Number of RecoverPoint appliances.
   - RPA Type—RecoverPoint appliance type.
   - Time Zone —Time zone.
   - Maintenance Mode—Maintenance mode in use.
   - Internal cluster name—Internal name of the cluster.

Viewing RecoverPoint splitters

Before you begin

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to view RecoverPoint splitters.

To view RecoverPoint splitters:

Procedure

1. Select the storage system.
3. Select a RecoverPoint system.
4. Select a system and click View Details to open the cluster list view.
5. Select a cluster and click View Details to open the cluster details view.
6. In the Related Objects pane, click Splitters to open the RecoverPoint splitters list view.

   The following information displays:
   - Splitter Name—Name of the splitter.
**Viewing RecoverPoint appliances**

**Before you begin**

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
   
   Opens the Recover Point Systems view.
3. Select a RecoverPoint system.
4. Select a system and click View Details.
   
   Opens the cluster list view.
5. Select a cluster and click View Details.
   
   Opens the cluster details view.
6. In the Related Objects pane, click RecoverPoint Appliances.
   
   Opens the RecoverPoint appliances view and displays the following information:

   - **RPA Name**—Name of the RecoverPoint appliance.
   - **Status**—Status of the RecoverPoint appliance.
   - **Private IP**—Private IP address
   - **Management IPv4**—IP address, in IPv4 format.
   - **Local RPA Fibre Connectivity**—Local RPA Fibre Connectivity
   - **Remote RPA Connectivity**—Remote RPA Fibre Connectivity

**RecoverPoint systems**

**Discovering RecoverPoint Systems**

**Before you begin**

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- This operation requires StorageAdmin privileges.

**Procedure**

1. Select the storage system.
   
   Opens the Recover Point Systems view.
3. Click Discover RecoverPoint System.
   Opens the Discover RecoverPoint System dialog box.

4. In the Discover RecoverPoint System dialog box, type the following information:
   - **System Name**—RecoverPoint system name.
   - **System IPv4**—System IP address, in IPv4 format.
   - **System Port**—System port number.
   - **System Username**—System username.
   - **System Password**—System password.
   - **Confirm System Password**—Re-enter system password.

5. Click OK.

Deleting RecoverPoint systems

**Before you begin**
RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**
1. Select the storage system.
   Opens the Recover Point Systems view.
3. Select one or more systems and click Delete.
4. Click OK.

Updating RecoverPoint discovery information

**Before you begin**
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- This operation requires StorageAdmin privileges.

**Procedure**
1. Select the storage system.
   Opens the Recover Point Systems view.
3. Select a RecoverPoint system.
4. Click Update Discover Information.
   Opens the Update Discover RecoverPoint System dialog box.
5. In the Update Discover RecoverPoint System dialog box, type the following information.
   - **System Port** — System port number.
Viewing RecoverPoint systems

Before you begin

RecoverPoint operations on Unisphere for VMAX require 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to view previously discovered RecoverPoint systems.

To view RecoverPoint systems:

Procedure

1. Select the storage system.

   The RecoverPoint Systems view contains two tabs (Local Systems and All Systems). The following properties display, depending on the tab:

   **Local Systems tab:**
   - **System Name**—Name of the local system.
   - **IPv4 Address**—IP address of the system.
   - **Clusters**—Number of RPA clusters in the system.
   - **Consistency Groups**—Number of consistency groups associated with the system.
   - **Error Events**—Number of events reported for the system.
   - **Error Alerts**—Number of alerts reported for the system.

   **All Systems tab:**
   - **System Name**—Name of the system.
   - **IP**—IP address of the system.
   - **Clusters**—Number of RPA clusters in the system.
   - **Consistency**—Number of consistency groups associated with the system.
   - **Error Events**—Number of events reported for the system.
   - **Error Alerts**—Number of alerts reported for the system.

The following controls are available on both tabs:

- **Discover RecoverPoint System**—Discovering RecoverPoint Systems on page 594
- **Update Discovery Information**—Updating RecoverPoint discovery information on page 595
- **View Details**—Viewing RecoverPoint system details on page 597
- **Delete**—Deleting RecoverPoint systems on page 595
Viewing RecoverPoint system details

**Before you begin**

RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To view RecoverPoint system details:

**Procedure**

1. Select the storage system.
3. Select the system and click **View Details to open its Details view**.

   The following properties display:
   - **RPA Cluster Name** — Name of the RPA cluster.
   - **RPAs** — Number of RecoverPoint appliances.
   - **Management IPv4** — IP address, in IPv4 format. If an IPv6 address is used, this column has the value "N/A".
   - **Management IPv6** — IP address, in IPv6 format. If an IPv4 address is used, this column has the value "N/A".
   - **RPA Type** — RecoverPoint appliance type.
   - **Management Mode** — Maintenance mode in use.

RecoverPoint consistency groups

Viewing RecoverPoint consistency groups

**Before you begin**

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the consistency groups used to protect the RecoverPoint volumes.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > RecoverPoint**.

   Opens the RecoverPoint view.
3. Select a RecoverPoint system and click **View Details**.

   Opens the **Consistency Group** list view which lists the consistency groups on the selected RecoverPoint system.

   The following properties display:
   - **Consistency Group** — Consistency group name.
   - **Group State** — Consistency group state.
**Link States**—Lists the states of associated links.

**Source Capacity (GB)**—Source capacity in GB.

**Primary RPA**—Primary RecoverPoint appliance number.

**Production Copy**—Name of the production copy.

The following controls are available:

- **View Details**—Viewing RecoverPoint consistency group details on page 598
- **Copies**—Viewing RecoverPoint copies on page 585
- **Replication Sets**—Viewing RecoverPoint replication sets on page 600
- **Links**—Viewing RecoverPoint links on page 602

Viewing RecoverPoint consistency group details

**Before you begin**

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

**Procedure**

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
   
   Opens the RecoverPoint view.
3. Select a RecoverPoint system and click View Details.
   
   Opens the Consistency Group list view.
4. Select a consistency group and click View Details to view the properties of that consistency Consistency Group.
   
   Displays the properties of the Consistency Group.

   The following properties display:
   
   - **Group State**—State of the group.
   - **Group Setting**—Group setting.
   - **Production Copy**—Name of the production copy.
   - **Copies**—Number of associated copies.
   - **Replication Sets**—Number of associated replication sets.
   - **Active Links**—Number of active links.
   - **Passive Links**—Number of passive links.
   - **Link States**—Lists the states of associated links.
   - **Distributed Group**—Distributed group.
   - **Managed by RecoverPoint**—Indicates if the consistency group is managed by RecoverPoint.
   - **Read Only Replica Volumes**—Read-only replica volumes.
RecoverPoint copies

Viewing RecoverPoint copies

Before you begin

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint copies for a particular consistency group.

Procedure

1. Select the storage system.
2. Select **Data Protection** > **RecoverPoint**.
   
   Opens the **RecoverPoint** view.
3. Select a RecoverPoint system and click **View Details**.
   
   Opens the **Consistency Group** list view.
4. Select a RecoverPoint consistency group and click **Copies**.
   
   Opens the **Copies** list view which lists the consistency groups on the selected RecoverPoint system.
   
   The following properties display:
   
   - **Name** — Name of copy.
   - **State** — State of the copy. Valid values are **Enabled** or **Suspended**.
   - **Copy Size** — Size of the copy.
   - **Copy Role** — Current role of the copy. Valid values are **Active** or **Replica**.
   - **RTO** — Recovery time objective
   - **Journal State** — Indicates the state of the journal. Valid values include **Locked** and **Distributing**.
   - **Journal Size** — Size of the journal, in GB.

   The following controls are available:
   
   - **View Details** — Viewing RecoverPoint copy details on page 585

Viewing RecoverPoint copy details

Before you begin

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

Procedure

1. Select the storage system.
2. Select **Data Protection** > **RecoverPoint**.
   
   Opens the **RecoverPoint** view.
3. Select a RecoverPoint system and click **View Details**.
   Opens the **Consistency Group** list view.

4. Select a RecoverPoint consistency group and click **Copies**.
   Opens the **Copies** list view.

5. Select a copy and click **View Details**.
   Opens the copy's details view.
   The following properties display:
   - **Name**—Name of copy.
   - **State**—State of the copy. Valid values are **Enabled** or **Suspended**.
   - **Role**—Current role of the copy. Valid values are **Active** or **Replica**.
   - **Copy Size**—Size of the copy.
   - **Journal Size**—Size of the journal, in GB.
   - **Journal State**—Indicates the state of the journal. Valid values include **Locked** and **Distributing**.
   - **Journal Volume Name**—Indicates the state of the journal. Valid values include **Locked** and **Distributing**.
   - **Cluster**—Indicates the state of the journal. Valid values include **Locked** and **Distributing**.
   - **RTO (seconds)**—Recovery time objective in seconds
   - **Journal Size Limit**—Journal size limit
   - **AllowDistribOfLargeSnaps**—Allow distribution of large snapshots
   - **AllowSymmWithOneRPA**—Allow storage sytem with one RPA
   - **ActivePrimaryRPA**—Active primary RPA
   - **FastForwardBound**—Fast forward bound
   - **NumCopySplitters**—Number of copy splitters
   - **NumCopyVolumes**—Number of copy volumes
   - **NumJournalVolumes**—Number of journal volumes
   - **PhoenixDevices**—Phoenix devices
   - **TspWritesCleared**—Tsp writes cleared
   - **UserSnapshot**—User snapshot
   - **Production Copy**—Production copy.
   - **Volumes**—Number of associated volumes.
   - **Copy Capacity (GB)**—Capacity of the copy, in GB.

**RecoverPoint replication sets**

Viewing RecoverPoint replication sets

**Before you begin**
- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.
This procedure explains how to view the RecoverPoint replication sets for a particular consistency group.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > RecoverPoint**.
   
   Opens the **RecoverPoint** list view.
3. Select a RecoverPoint system and click **View Details**.
   
   Opens the **Consistency Group** list view.
4. Select a RecoverPoint consistency group and click **Replication Sets**.
   
   Opens the **Replication Sets** list view, which lists replication sets associated with the selected consistency group.
   
   The following properties display:
   - **Name**—Name of the replication set.
   - **Capacity (GB)**—Source capacity, in GB.
   - **Production Volume Capacity (GB)**—Production volume capacity, in GB.
   - **Volumes**—Number of associated volumes.
   
   The following control is available:
   - **View Details**—[Viewing RecoverPoint replication set details](#) on page 601

**Viewing RecoverPoint replication set details**

**Before you begin**

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the details of a RecoverPoint replication set.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > RecoverPoint**.
   
   Opens the **RecoverPoint** view.
3. Select a RecoverPoint system and click **View Details**.
   
   Opens the **Consistency Group** list view.
4. Select a RecoverPoint consistency group and click **Replication Sets**.
   
   Opens the **Replication Sets** list view.
5. Select a replication set, and click **View Details**.

   The following properties display:
   - **Name**—Name of the replication set.
   - **Volumes**—Number of associated volumes.
   - **Volume Name**—Name of associated volume.
   - **Production Volume Capacity (GB)**—Production volume capacity, in GB.
RecoverPoint links

Viewing RecoverPoint links

Before you begin

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint links for a particular consistency group.

Procedure

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
   
   Opens the RecoverPoint view.
3. Select a RecoverPoint system and click View Details.
   
   Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click Links.
   
   Opens the Links list view, which lists the links associated with the selected consistency group.

   The following properties display:
   - Name — Name of the RecoverPoint link.
   - Transfer State — Indicates if the transfer state is enabled for this RecoverPoint link.
   - Link State — Current role of the copy. Valid values are Active or Replica.
   - Local — Indicates if the link state is active or paused.
   - Protection Mode — Protection Mode.

   The following control is available:
   - View Details — Viewing RecoverPoint link details on page 602

Viewing RecoverPoint link details

Before you begin

- RecoverPoint operations on Unisphere for VMAX require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

Procedure

1. Select the storage system.
2. Select Data Protection > RecoverPoint.
   
   Opens the RecoverPoint view.
3. Select a RecoverPoint system and click View Details.
   
   Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click Links.
   Opens the Links list view.

5. Select a link and click View Details.
   Opens the link's details view.
   The following properties display:
   - **Name**—Name of the RecoverPoint link.
   - **Transfer State**—Indicates if the transfer state is enabled for this RecoverPoint link.
   - **Link State**—Indicates if the link state is active or paused.
   - **Local**—Indicates if the link is local.
   - **RPO (seconds)**—Recovery point objective in seconds.
   - **First Copy**—First copy.
   - **Second Copy**—Second copy.
   - **Protection Mode**—Protection Mode.
   - **Replication Over WAN**—Indicates if replication over WAN is supported.
   - **WAN Compression**— Specifies what WAN compression, if any, is being used.
   - **Bandwidth Limit**—Bandwidth limit.
   - **Deduplication**—Specifies if deduplication is enabled.
   - **Snapshot Granularity**—Snapshot granularity.

## Creating Open Replicator copy sessions

### Before you begin

When the ORS control volumes are on a storage system running HYPERMAX OS 5977 or higher, the following session options cannot be used:

- Push
- Differential
- Precopy

There are many rules and limitations for running Open Replicator sessions. Refer to the *Solutions Enabler Migration CLI Product Guide* before creating a session. For a quick reference, refer to Open Replicator session options.

### Procedure

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator SAN View.
3. Click Create Copy Session.
4. Select a Copy Direction and Copy Operation.
5. Click Next.

   The Source - Remote Volumes lists the remote volumes from the Open Replicator remote volumes list view. The Target - Control Volumes lists all the control volumes that can be paired with the remote volumes.
For a cold push session, one control volume can concurrently push data to up to 16 remote volumes. For cold pull, hot push, and hot pull sessions only one control volume can push/pull to one remote device.

6. Select a remote volume and target volume, then click Add Pair.
   If the pair is valid, it is added to the Volume Pairs list.
7. Click Remove Pair to edit the Volume Pairs list.
8. Click Next.
9. Enter Session Name.
10. Enter Copy Pace value (0 - slowest to 9 - fastest).
    With offline copying, there is a slight pause between each track write. You can speed up a copy operation by reducing or eliminating this pause. While in the CopyInProgress or CopyOnAccess state, set a pace value higher than the default of 5. Setting the copy pace to 9 eliminates this pause.
    This feature is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.
11. Select the Open Replicator session options and click Next.
12. View session Summary and click Finish to create session or click Back to edit session options.

Managing Open Replicator sessions

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator SAN View.
   Use this view to view select remote volumes to use for Open Replicator and FLM (Federated Live Migration) copy sessions. The list of volumes can be filtered further by selecting the objects within the tree views.

Activating Open Replicator session

Before you begin
The copy session must be in a created or recreated state before you can activate it.

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions to open the Open Replicator Sessions list view.
3. Select a session and click Activate to open the Activate Session dialog box.
4. Select a copy option.
   Refer to Open Replicator session options for session copy and control options.
5. Click OK.

Restoring Open Replicator sessions

Before you begin
- The restore operation restores the copy session back to the control volume by pulling back only the changed tracks from the remote volume. The session must
have been created with differential copying, and must be in the copied state. Hot or cold differential push sessions can be restored.

- Restore operations are not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions**.
3. Select a session and click **Restore**.
4. Select any number of the available options. Refer to **Open Replicator session options** for session control options.
5. Click **OK**.

**Renaming Open Replicator sessions**

**Before you begin**

Renaming operations are not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions**.
3. Select a session and click **Rename**.
4. Type a new name for the session.
5. Click **OK**.

**Removing Open Replicator sessions**

**Before you begin**

Removing Open Replicator sessions is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions**.
3. Select a session and click **Remove**, and click **OK**.
   
   An error message is displayed if the session is in a state that does not allow the session to be removed.

**Setting Open Replicator session background copy mode**

**Before you begin**

Setting background copy mode to precopy is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

This procedure sets the session background copy mode for an ORS session that has already been created.

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions**.
3. Select a session and click **Set Mode**.
4. Select the background copy mode. Refer to **Open Replicator session options** for session control options.
5. Click **OK**.

### Setting Open Replicator session donor update off

This procedure deactivates donor update for a session that was created with donor update.

#### Procedure

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions** to open the **Open Replicator Sessions** list view.
3. Select a session and click **Donor Update Off** to open the **Set Donor Update Off** dialog box.
4. Select the **Open Replicator session options**.
5. Click **OK**.

### Setting Open Replicator session front end zero detection off

This procedure deactivates front end zero detection for a session that was created with front end zero.

#### Procedure

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions** to open the **Open Replicator Sessions** list view.
3. Select a session and click **Frontend Zero Off** to open **Set Frontend Zero Off** dialog box.
   - Refer to **Open Replicator session options** for session control options.
4. Click **OK**.

### Setting Open Replicator session pace

**Before you begin**

This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure sets how fast data copies between volumes during an ORS session. Values can range from 0 to 9, with 0 being the fastest pace, and 9 being the slowest pace. If set to 0, there is no inserted delay time and the replication will proceed as fast as possible.

Values of 1 - 9 add delays, which takes longer to complete copying but conserves system resources. The default for both online (hot) replication and offline (cold) replication is 5.

#### Procedure

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Set Pace.
4. Type a Pace value (0 - fastest to 9 - slowest).
5. Click OK.

Setting Open Replicator ceiling

The Open Replicator ceiling value is the percentage of bandwidth available for background copying. You should only set this value after understanding the bandwidth being used by other applications. By default, the ceiling value is NONE.

Procedure
1. Select a storage system.
2. Select System > System Dashboard > Front End Directors to open the Front End Directors list view.
3. Select a director and click Set ORS Ceiling to open the Set ORS Ceiling dialog box.
4. Type a Open Replicator Ceiling value from 1 (minimum) to 100 (maximum) and click OK.

Terminating Open Replicator sessions

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions View to open the Open Replicator SAN View.
3. Select a session and click Terminate to open the Terminate confirmation dialog box.
4. Select terminate options.
   Refer to Open Replicator session options for session control options.
5. Click OK.

Viewing Open Replicator sessions

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions View to open the Open Replicator Sessions View.
Use the this view to view and manage Open Replicator sessions.

The following properties display:
- Session—ORS session name.
- Control Volume—Control volume name.
- Remote Volume—Remote volume name.
- Status—Session status.
- Protected Tracks—Number of protected tracks.

Open Replicator session options indicated as enabled for the session by the green icon:
• FLM session
• Background Copy
• Differential Copy
• Pull Session
• Cold Copy Session
• Donor Update
• Front End Zero Detection

The following controls are available:

• **View Details** — [Viewing Open Replicator session details](#) on page 608
• **Activate** — [Activating Open Replicator session](#) on page 604
• **Terminate** — [Terminating Open Replicator sessions](#) on page 607
• **Remove** — [Removing Open Replicator sessions](#) on page 605 This option is not available for VMAX3 systems.
• **Front End Zero Off** — [Setting Open Replicator session donor update off](#) on page 606
• **Donor Update Off** — [Setting Open Replicator session donor update off](#) on page 606
• **Rename** — [Renaming Open Replicator sessions](#) on page 605 This option is not available for VMAX3 systems.
• **Remove** — [Removing Open Replicator sessions](#) on page 605 This option is not available for VMAX3 systems.
• **Restore** — [Restoring Open Replicator sessions](#) on page 604 This option is not available for VMAX3 systems.
• **Set Pace** — [Setting Open Replicator session pace](#) on page 606 This option is not available for VMAX3 systems.
• **Set Mode** — [Setting Open Replicator session background copy mode](#) on page 605

### Viewing Open Replicator session details

**Procedure**

1. Select the storage system.
2. Select *Data Protection* > *Open Replicator* > *Open Replicator Sessions View* to open the *Open Replicator Sessions View*.
3. Select a session and click **View Details** to open the session details view.

Depending on the configured system, some or all of the following properties display:

• **Session** — ORS session name.
• **Control Volume** — Control volume name.
• **Remote Volume** — Remote volume name.
- **Status**—Session status.
- **Percent Complete**— Percent tracks copied. Not applicable for VMAX3 systems.
- **Copy Pace**—Copy Pace value (0 - slowest to 9 - fastest, default is 5). Not applicable for VMAX3 systems.
- **Protected Tracks**—Number of protected tracks.
- **Number of Modified Tracks**—Number of modified tracks. Not applicable for VMAX3 systems.
- **Background Copy**—Indicates if background copying is enabled.
- **Differential Copy**—Indicates if differential copying is enabled.
- **Pull Session**—Indicates if session is a pull session = Yes, or a push session = No.
- **Cold Copy Session**—Indicates if session is a cold copy session = Yes, or a hot copy session = No.
- **Donor Update**—Indicates if donor update is enabled.
- **FLM Session**—Indicates if session is a FLM session.
- **RecoverPoint Session**—Indicates if session is a RecoverPoint session. Not applicable for VMAX3 systems.
- **Standard ORS Session**—Indicates if session is a standard session. Not applicable for VMAX3 systems.
- **Front-End Zero Detection**—Indicates if front-end zero detection is enabled.

### Open Replicator session options

Depending on the operation you are performing, some of the following options may not apply.

<table>
<thead>
<tr>
<th>Session Option</th>
<th>Used with Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>Activate</td>
<td>Causes the volume pairs to be consistently activated.</td>
</tr>
<tr>
<td></td>
<td>Donor Update Off</td>
<td>Consistently stops the donor update portion of a session and maintains the consistency of data on the remote volumes.</td>
</tr>
<tr>
<td>Copy</td>
<td>Create</td>
<td>Volume copy takes place in the background. This is the default for both pull and push sessions.</td>
</tr>
<tr>
<td>Cold</td>
<td>Create</td>
<td>Control volume is write disabled to the host while the copy operation is in progress. A cold copy session can be created as long as one or more directors discovers the remote device.</td>
</tr>
<tr>
<td>Differential</td>
<td>Create</td>
<td>Creates a one-time full volume copy. Only sessions created with</td>
</tr>
<tr>
<td>Session Option</td>
<td>Used with Command</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the differential option can be recreated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For push operations, this option is selected by default.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For pull operations, this option is cleared by default (no differential session).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td>Donor Update</td>
<td>Create</td>
<td>Causes data written to the control volume during a hot pull to also be written to the remote volume.</td>
</tr>
<tr>
<td></td>
<td>Incremental Restore</td>
<td>Maintains a remote copy of any newly written data while the Open Replicator session is restoring.</td>
</tr>
<tr>
<td>Force</td>
<td>Terminate</td>
<td>Select the <strong>Force</strong> option if the copy session is in progress. This will allow the session to continue to copy in its current mode without donor update.</td>
</tr>
<tr>
<td></td>
<td>Restore</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Donor Update Off</td>
<td>Select the <strong>Force</strong> option if the copy session is in progress. This will allow the session to continue to copy in its current mode without donor update.</td>
</tr>
<tr>
<td>Force Copy</td>
<td>Activate</td>
<td>Overrides any volume restrictions and allows a data copy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For a push operation, remote capacity must be equal to or larger than the control volume extents and vice versa for a pull operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The exception to this is when you have pushed data to a remote volume that is larger than the control volume, and you want to pull the data back, you can use the <strong>Force_Copy</strong> option.</td>
</tr>
<tr>
<td>Front-End Zero Detection</td>
<td>Create</td>
<td>Enables front end zero detection for thin control volumes in the session. Front end zero detection looks for incoming zero patterns from the remote volume, and instead of writing the incoming data of all zeros to the thin control volume, the group on the thin volume is de-allocated.</td>
</tr>
<tr>
<td>Session Option</td>
<td>Used with Command</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Hot</td>
<td>Create</td>
<td>Hot copying allows the control device to be read/write online to the host while the copy operation is in progress. All directors that have the local devices mapped are required to participate in the session. A hot copy session cannot be created unless all directors can discover the remote device.</td>
</tr>
<tr>
<td>Nocopy</td>
<td>Activate</td>
<td>Temporarily stops the background copying for a session by changing the state to CopyOnAccess or CopyOnWrite from CopyInProg.</td>
</tr>
<tr>
<td>Pull</td>
<td>Create</td>
<td>A pull operation copies data to the control device from the remote device.</td>
</tr>
<tr>
<td>Push</td>
<td>Create</td>
<td>A push operation copies data from the control volume to the remote volume. This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td>Precopy</td>
<td>Create, Recreate</td>
<td>For hot push sessions only, begins immediately copying data in the background before the session is activated. This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td>SymForce</td>
<td>Terminate</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
</tr>
</tbody>
</table>

### Open Replicator flags

<table>
<thead>
<tr>
<th>Flag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Background copying</td>
<td>X = Enabled, . = Disabled</td>
</tr>
<tr>
<td>D Differential copying</td>
<td>X = Enabled, . = Disabled</td>
</tr>
</tbody>
</table>
## Filtering remote volumes for sessions

**Procedure**

1. Single or multi-select (hold the Shift key and select) the items in the tree view. As each selection is made, the filtered results table of remote volumes is updated to reflect the current filter criteria. The filtered remote volumes list is used in the create session wizard to determine which control volumes that can be paired with the remote volumes.

## Understanding Federated Live Migration

Federated Live Migration (FLM) allows you to move data from older storage into a VMAX Series system nondisruptively. The host application cutover to use the VMAX Series volumes is made transparent by a combination of presenting the VMAX Series volumes as additional paths to the old volumes and managing which paths are active through a multipath IO (MPIO) driver on the host. FLM supports PowerPath as the application MPIO driver, and will support additional MPIO drivers in the future. FLM supports moving the data with Open Replicator SAN-based replication, and will support other underlying technologies in the future. Unlike application host-based PPME, control of the migration and cutover is managed through the Symmetrix VMAX Series system. FLM greatly simplifies migrations requiring no remediation when migrating pre-qualified stacks.

### Note

Federated Live Migration is not supported on storage systems running HYPERMAX OS 5977. For information on supported operating systems, file systems, and logical volume managers, refer to the Federated Live Migration Simple Support Matrix.

An example FLM configuration including the network, storage systems, application hosts, and host is shown below:

Unisphere for VMAX includes a Federated Live Migration wizard to guide you through the process of creating the Federated Live Migration session and the necessary
masking view; however, you must set up the required zones before using the wizard. This includes the zones from the application hosts to the target storage system and from the source storage system to the target storage system. For instructions, refer to Setting up/Running Federated Live Migration on page 613.

Setting up/Running Federated Live Migration

Before you begin

Data migrations are often complex operations and require careful planning and execution of predetermined procedures. Failure to identify and perform all steps sequentially or work within supported configurations can result in data unavailability or loss.

Due to requirements of multipath environments, you must correctly configure paths to the new Symmetrix VMAX Series volumes to maintain data availability. For details on properly configuring your host environment, refer to Federated Live Migration Technical Overview Technical Notes.

There are three primary tasks involved with setting up an running a Federate Live Migration:

- Reading the environment
- Creating the migration session and masking view
- Migrating the data
### Readying environment for migration

![Diagram showing application server, SYM API server, and target Symmetrix system with active and passive data paths.]

#### Procedure

1. Verify that the application is running on the source storage system and that the storage system is zoned to the application and SYMAPI servers, as shown next:

2. Create/modify zoning to support connectivity of the target storage system to the following:
   - Application Server (application access to the target storage system)
   - SYMAPI server (control of the target storage system)
   - Source storage system (application data transfer)

   As shown next:
Creating the migration session and masking view

Procedure

1. Start the Federated Live Migration wizard.

   The wizard will guide you through the process of setting up a Federated Live Migration session, including defining the storage, port, and initiator groups; and the masking view. For instructions on using the wizard, see Creating a FLM session on page 617. After you have finished the wizard, you will have a Federated Live Migration session and a masking view that will provide a data path for the migrated host application.

2. Verify that the application server has discovered the devices and that the multipathing software has created the paths. In addition, you should also verify that the ORS ceiling parameter is set to 100%, unless it is adversely affecting applications that share the FA port.

   Proceed to migrate the data.
Migrating the data

Procedure

1. Activate the Federated Live Migration session.

2. Once the migration completes (i.e., all the data has been transferred to the target storage system), terminate the session, as described in the \textit{Solutions Enabler Migration CLI Product Guide}. To reset the identities of the volumes used in the migration session, use the \texttt{symconfigure} command. For instructions, refer to the \textit{Solutions Enabler Migration CLI Product Guide}.

\underline{Note}

The host may run indefinitely with federated identity on the new storage system volumes; however, it is recommended that the spoofed identity be removed as soon as it is practical to do so following the migration. Leaving the identity spoofing in place long-term has the potential to cause confusion for systems administrators or other users who may not be familiar with the details of FLM and how volume identities are federated. This recommendation is provided only to raise awareness and is not intended as a mandate for unspoofing; storage system volumes may remain federated indefinitely and there is no requirement to unspoof at any time.

\underline{Results}

The source storage system is no longer connected to the application or SYMAPI server, as shown below:
Creating a FLM session

Before you begin
This feature is not supported on storage systems running HYPERMAX OS 5977.
There are many environment rules and specifications for running Federated Live Migration (FLM) sessions. Refer to the Solutions Enabler Data Migration CLI Product Guide before creating a session.

Procedure
1. Select Data Protection > Open Replicator > Open Replicator SAN View.
2. Filter the remote volumes, as described in Managing Open Replicator sessions on page 604.
3. Select the volumes and click Create FLM Session to open Create FLM Session to open the Federated Live Migration wizard.
4. Select the Volumes Source.
5. Non-array source only: Type or select a Source Name.
6. Click Next and follow one of the options:
   - Auto-match source and target volumes:
a. Click **Match Selected** to pair your selected source volumes with target volumes.

b. Click **Match All** to pair all the listed source array volumes with target volumes.

   The volume pairs display in the **Selected volume pairs** table.

**Note**

If needed, use the **Remove** button to clear all selected pairs from the table.

- Manual selection of source and target volumes:
  a. Select volumes from the **Source array** table and volumes from the **Target array** table and click **Add Pair**.
  b. Select volumes from the **Source array** table and click **Match Selected** to automatically create pairs.

   The volume pairs display in the **Selected volume pairs** table.

**Note**

If needed, use the **Remove** button to clear all selected pairs from the table.

7. Click **Next** to open the **Specify Session Options** page.

8. Type a **Session Name** and select the **Host OS**.

9. Type the **HBA type** and **MP type** (these values may be required based on the selection of the Host OS.)

10. Optional: Select **Front End Zero Detect**.

    This feature provides improved performance of pull sessions to thin devices through the detection of incoming zero patterns.

11. Click **Next** to open the **Create Target Storage Group** page.

12. Optional: Type a **Storage group name** to change the generated storage group name.

13. Click **Next** to open the **Create Target Port Group** page and follow one of the options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Create new</strong></td>
<td>Type a <strong>Port Group Name</strong>, select the ports to add to the port group.</td>
</tr>
<tr>
<td><strong>Select existing</strong></td>
<td>This option automatically selects from a list of available ports.</td>
</tr>
</tbody>
</table>

14. Click **Next** to open the **Create Target Initiator Group** page and follow one of the options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Create new</strong></td>
<td>Type an <strong>Initiator Group Name</strong>, and select the initiators/initiator groups to add to the initiator group.</td>
</tr>
<tr>
<td><strong>Select existing</strong></td>
<td>This option automatically selects from a list of available initiators.</td>
</tr>
</tbody>
</table>
At least one initiator group must be selected in the Initiator/Initiator Group table.

15. Click Next to open the Create Target Masking View page.

16. Optional: Enter a Masking view name to change the generated masking view name and click Finish.
CHAPTER 7
Performance Management

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- Charts View ................................................................. 674
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Dashboard View

A dashboard is a collection of charts that you define, or that Unisphere for VMAX provides. A user-defined dashboard must have a unique name, up to 32 characters. In addition a user-defined dashboard can be saved to a named folder, or to the default User Dashboards folder. You can use folders to separate systems, applications, or any other object. The folder name displays in the dashboards tree.

The tree view for the dashboards provides the organization of the dashboard folders. Unisphere for VMAX provides folders for User Dashboards, User Templates, and EMC Views.

Charts and heatmaps that you create can be saved, edited, and deleted.

The dashboards under EMC Views are created dynamically and provide the following benefits:

- Easy visualization.
- Event correlation between application response time and hardware component utilization taken at a particular point in time.
- Fast problem recognition.

You can save an EMC dashboard as a template.

The heatmap under EMC Views displays hardware instances represented as colored squares, with the color indicating utilization levels. Clicking on any square displays Utilization and Queue Depth information for that hardware instance.

The specific information displayed in a heatmap depends on the model of the selected storage system and whether any filters have been applied.

The specific information displayed in a Utilization summary dashboard view depends on the selected Symmetrix ID and Category. Unless the selected category is Array, the information is filtered for the selected category (for example, Database or Storage Group).

To manage dashboards:

- Creating a template dashboard from an Analyze view on page 634
- Creating a dashboard with charts on page 624
- Copying a dashboard on page 624
- Saving a dashboard as a template on page 626
- Viewing dashboards on page 623
- Deleting dashboards on page 625
- Saving dashboards and charts on page 811

To manage EMC dashboards:

- Managing EMC views on page 627

To manage EMC summary dashboards:

- Using EMC summary dashboards on page 628

To manage projection dashboards:

- Plan View on page 678
Viewing dashboards

Before you begin
Read Dashboard View on page 622.

To view dashboards:

Procedure

1. Select Performance > Monitor.

The left section of the Dashboards view displays folders and dashboards:

EMC Views
This folder contains a predefined dashboard, summary and heatmap. The dashboards can be modified dynamically, but cannot be deleted. They can be modified and saved as a template.

User Dashboards
This default folder is the container for user-defined dashboards. You can also create additional folders for user-defined dashboards.

User Templates
This folder is the container for any dashboard that you want to save. For example, you can configure any of the EMC dashboards dynamically, and then save it as a template to eliminate the need to configure it again.

When viewing a dashboard, the right section of the view displays the selected dashboard. The bottom of the view block provides dynamic configuration controls, when applicable.

Depending on the selected dashboard, some of the following controls are available:

- **Save as** — A drop-down menu containing some or all of the following options:
  - **Dashboard** — Saving dashboard changes on page 626
  - **Template** — Saving a dashboard as a template on page 626
  - **JPG** — Saving dashboards and charts on page 811
  - **PNG** — Saving dashboards and charts on page 811
  - **PDF - Charts** — Saving dashboards and charts on page 811
  - **PDF - Chart & Data** — Saving dashboards and charts on page 811
- **Schedule Report** — Scheduling a report from the dashboard on page 627
- **Edit** — Editing dashboards on page 625
- **Save** — Saving dashboard changes on page 626
- **Copy** — Copying a dashboard on page 624
- **Delete** — Deleting dashboards on page 625
- **Navigate to Details View** — Navigating to the Details view on page 632
- **Navigate to Analyze** — Navigating from a heatmap to an analyze view on page 627
Creating a dashboard or template folder

You can create a new folder for dashboards or templates manually. Alternatively, you can create a new folder as part of the process when creating a new dashboard or saving a new template.

To create a dashboard or template folder:

**Procedure**

1. Select **Performance > Monitor** to open the Monitor view.
2. Right-click on the **User Dashboards** or **User Templates** folder in the dashboards tree. Select **New Folder**.
3. Enter a folder name and click **OK**.
4. The folder displays in the **User Dashboards** or **User Templates** section of the dashboards tree.

Creating a dashboard with charts

To create a dashboard with charts:

**Procedure**

1. Select component(s) from the table in Analyze view, and create one or more charts.
2. Click **Save As Dashboard**. The **Create Dashboard** dialog box displays.
3. Specify a dashboard name and folder.
4. (Optional) Set this dashboard as the default. This means that this dashboard displays each time you enter Monitor view. Each user can have only one default dashboard.
5. Click **OK** to save the dashboard.

Copying a dashboard

You can copy an existing dashboard and change the name and some characteristics to make a new dashboard.

To copy a dashboard:

**Procedure**

1. Select the dashboard to copy and click **Copy** to open the **Copy Dashboard** or **Copy Template** dialog box, depending on the dashboard type.
2. Type a **Name** for the copied dashboard.
3. Select a **Folder** for the dashboard location, or select **Create new folder**.
4. User Dashboards only: Set this dashboard as the default. This means that this dashboard displays each time you enter Monitor view. Each user can have only one default dashboard.
5. Template Dashboards only: Select the **Instances** for the new dashboard.
6. (Optional) Select a chart from the list of charts and use **Delete** or **Edit** to customize the copied dashboard.
7. Click **OK**.
**Editing a template dashboard**

To edit a template dashboard:

**Procedure**

1. Select **Performance > Monitor** to view the list of user dashboards and user template dashboards.
2. In the dashboards tree, select the user template dashboard you want to edit and click **Edit**.
3. (Optional) Change the dashboard **Name**.
4. (Optional) Change the dashboard **Folder**.
5. (Optional) Change the value in **Instances**.
6. (Optional) Select an item from the list of charts. Perform one or more of the following actions:
   a. Click **Edit** to open the **Edit Snapshot Chart** dialog box. Change the chart **Title**, **Symmetrix ID**, **Chart Style**, **Data Format**, or **Time Range** and click **OK**. Note that depending on the dashboard type, not all options are available.
   b. Click **Delete** to delete the chart from the list. Deleting a chart requires a confirmation **OK**.
   c. Click **Add** to add a chart to the list.
7. Click **OK**.

**Editing dashboards**

To edit a dashboard:

**Procedure**

1. Select **Performance > Monitor** to view the list of dashboards.
2. Select the dashboard and click **Edit** to open the **Edit Dashboard** dialog box.
3. (Optional) Change the dashboard **Folder** or set the dashboard as the default.
4. Select an item from the list of charts and click **Edit** to open the **Edit Snapshot Chart** dialog box.
5. Change the chart **Title**, **Symmetrix ID**, **Chart Style**, **Type**, **Data Format**, or **Time Range** and click **OK**.
6. Click **OK**.

**Deleting dashboards**

**Before you begin**

You can delete only user-defined dashboards. Predefined dashboards cannot be removed.

To delete a dashboard:

**Procedure**

1. Select **Performance > Monitor** to open Monitor view.
2. Select the dashboard you want to delete from the dashboard navigation tree and click **Delete**.
3. Click OK on the delete confirmation message.

Running a report from the dashboard

The performance dashboard reports are saved in PDF format. Dashboard reports show the charts and summary reports as they appear in the dashboard view. To create reports for other data formats (XML, CSV, and BTP), and to manage any scheduled reports, click Performance > Reports.

To run a report from the dashboard:

Procedure

1. Click Performance > Monitor to open the Monitor view.
2. Select or create a system dashboard.
3. Do one of the following:
   a. Click Save As > PDF - Charts.
   b. Click Save As > PDF - Chart & Data.
4. Type a file name in the Save File dialog box.
   The report (in PDF format) is saved to the specified location.
   Reports that are run by clicking Run Report Now do not appear in the Reports list.

Saving a dashboard as a template

Selected EMC-defined dashboards can be adjusted and saved as a template for your own dashboard.

To save a dashboard as a template:

Procedure

1. Select Performance > Monitor to open the Monitor view.
2. Select one of the EMC Dashboards.
3. Set the dashboard characteristics (Type, Time Range) at the top of the dashboard.
4. Click Save as > Template to open the Save Template dialog box.
5. Enter a dashboard Name, select a Folder, and select the Instances to monitor.
6. (Optional) If you have charts saved from the Analyze view, click Add to add them to the dashboard.
7. Click OK.

Saving dashboard changes

The Save option in the Monitor view allows you to save changes that you make dynamically to a dashboard chart using the chart controls.

To save dashboard changes:

Procedure

1. Click Performance > Monitor to view the list of dashboards.
2. In the dashboards tree, select the dashboard you want to change.
3. Update the chart properties, depending on the options available.
4. Click Save.

Managing EMC views

To view and manage EMC views:

Procedure

1. Select Performance > Monitor to open the Monitor view. The Dashboards view is displayed by default.

2. Select one of the following items from the EMC Views folder:
   - Array
   - Storage Groups
   - All Dashboards
   - Summary
   - Heatmap

3. Make your selections from the fields across the top of the dashboard.

   The dashboards update dynamically based on your selections.

   Using EMC summary dashboards on page 628 provides performance information for the specified storage system component.

Navigating from a heatmap to an analyze view

You can navigate from an EMC heatmap object to an analyze view.

To navigate to an analyze view from a heatmap:

Procedure

1. Select Performance > Monitor to open the Monitor view.

2. Select EMC Views > Heatmap.

3. (Optional) Select the Type (Real Time, Root Cause Analysis, or Trending & Planning) and the Time Range from the drop-down options above the heatmap.

4. Double-click on any object in the heatmap to open its corresponding analyze view.

5. Click Navigate to Analyze.

   The Root Cause Analysis view opens to the selected object's location.

Scheduling a report from the dashboard

The performance dashboard reports are saved in PDF format. When you schedule a report from the Monitor view, it will run on the time/days selected.

To schedule a report from the dashboard:

Procedure

1. Select Performance > Monitor to open the Monitor view.

2. Select or create a system dashboard.

3. Click Schedule Report to open the Create Report dialog box.
4. In the **General** tab, enter a report **Name**.

5. (Optional) Enter the report description.

6. In the **Schedule** tab, select **Schedule**.

7. Set **First Run Time**.

   The **First Run Time** is continually adjusted relative to the current time and the report execution interval. For example, if **First Run Time** is set to 3am, but the current time is 4am and the **Time Range** is set to 'Last 4 hours', then the value of **First Run Time** is changed to 7am.

8. Select the days on which the report will run.

9. From the **Retention (Days)** menu, select the number of days for which you want the schedule to apply.

10. (Optional) In the **Email** tab, configure email notifications.

11. Click **OK**.

   A confirmation message displays. Any changes to this scheduled report are made in **Performance > Reports**.

   Scheduled reports save to this default location:

   ```
   install_dir\SMAS\report\SPA\querydata\n   ```

### Using EMC summary dashboards

#### Before you begin

The EMC summary dashboards require Administrator, Monitor, or Performance Monitor permissions.

The following summary dashboards are available::

- Array — Arrays Summary on page 629
- BE Directors (DA) — BE Directors (DA) Summary on page 629
- External Directors — External Directors Summary on page 630
- External Disks — External Disks Summary on page 630
- FE Directors — FE Directors Summary on page 631
- Port Groups — Port Groups Summary on page 631
- RDF Directors — RDF Directors Summary on page 631
- Storage Groups — Storage Groups Summary on page 632

#### Procedure

1. Select **Performance > Monitor > EMC Views > Summary**.
2. Select a summary dashboard.
3. (Optional) To save a summary dashboard to a PDF file, select **Save As > PDF - Charts**, and specify a file name and directory location.
4. (Optional) To schedule a summary, select **Schedule Report**.

   Scheduled reports are listed in the **Performance > Reports** page.
When a scheduled report completes, it saves to the default location: \install_dir\SMAS\report\SPA\querydata.

Arrays Summary

The array summary can be scheduled. The following metrics are available for all storage systems:

**Host IOs/sec**
- The number of host IO operations performed each second by all volumes, including writes and random and sequential reads.

**Host MBs/sec**
- The number of host MBs read by all of the volumes each second.

**BE Reqs/sec**
- The number of read or write requests between the cache and the director.

**Avg Fall Thru Time**
- The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to is reuse by another address.

**WP Count**
- The number of system cache slots that are write pending.

**% Cache WP**
- The percent of cache that is busy with write pendings.

BE Directors (DA) Summary

The following metrics are available for all back-end directors:

**ID**
- The ID of the director.

**% Busy**
- The percent of time the director is busy.

**% Non-IO Busy**
- The percent of time the director is busy with non-IOs.

**IOs/sec**
- The number of IO commands to the disk.

**Reqs/sec**
- The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter is incremented at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.

**MBs Read/sec**
- The average throughput of host MBs read (per second) by the director.
MBs Written/sec
The average throughput of host MBs written (per second) by the director.

External Directors Summary
The following metrics are available for all external directors:

ID
The ID of the external director.

% Busy
The percent of time that the director is busy.

% Non-IO Busy
The percent of time the director is busy with non-IOs.

IOs/sec
The number of IO commands to the disk.

Reqs/sec
Data transfer between the director and the cache.

MBs Read/sec
The average throughput of host MBs read (per second) by the director.

MBs Written/sec
The average throughput of host MBs written (per second) by the director.

External Disks Summary
The following metrics are available for external disks:

ID
The ID of the external disk.

% Busy
The percent of time that the disk is busy serving IOs.

Avg Queue Depth
Calculated value: Accumulated queue depth / Total SCSI command per sec.

Reads/sec
The number of host reads per second for the disk.

Read RT (ms)
The average time it took the disk to serve one read command.

Writes/sec
The number of host writes per second for the disk.

Write RT (ms)
The average time it took the disk to serve one write command.

Total Capacity (GB)
The total capacity of the disk (GBs).
% Used Capacity
The percent of the total capacity that is used.

FE Directors Summary

The following metrics are available for all front-end directors:

ID
The ID of the director.

% Busy
The percent of time the directory is busy.

Host I/Os/sec
The number of host I/Os transferred through the director each second.

Host MBs/sec
The throughput of the director each second.

Reqs/sec
Data transfer between the director and the cache. An I/O may require multiple requests depending on I/O size, alignment or both. The requests rate should be either equal to or greater than the I/O rate.

Read RT (ms)
The calculated average response time for reads.

Write RT (ms)
The calculated average response time for writes.

Port Groups Summary

The following metrics are available for all port groups:

ID
The ID of the port group.

% Busy
The percent of time the port group is busy.

Host I/Os/sec
The number of host MBs read by all of the port groups each second.

Host MBs/sec
The number of host MBs read by all of the port groups each second.

RDF Directors Summary

The following metrics are available for all RDF directors:

ID
The ID of the director.

% Busy
The percent of time the directory is busy.
Avg IO Service Time (ms)
   The average time the director takes to serve IO.

IOs/sec
   The average IO count per second for the director.

MBs Sent/sec
   The size (throughput) of the data transfer in MBs from the director.

MBs Received/sec
   The size (throughput) of the data received in MBs by the director.

Storage Groups Summary
   The following metrics are available for all storage groups:

   ID
   The ID of the storage group.

   Host IOs/sec
   The number of host IO operations performed each second by the storage group.

   Response Time (ms)
   The average time that it took the storage system to respond to IO for this group.

   Host Reads/sec
   The number of host read operations performed each second by the group.

   Read RT (ms)
   The average time that it took the storage group to serve one read IO for this group.

   Host Writes/sec
   The number of host write operations performed each second by the group.

   Write RT (ms)
   The average time that it took the storage group to serve one write IO for this group.

   % Hit
   The percent of IO operations performed by the group that were immediately satisfied by cache.

   Allocated Capacity (GB)
   The allocated capacity of the storage group.

   Total Capacity (GB)
   The total capacity of the storage group.

Navigating to the Details view
   From many of the Dashboards in the Monitor view, you can navigate to the component’s details view.
If the Navigate to Details View button is dimmed, there is no corresponding detail view.

To navigate to the details view:

**Procedure**

1. Select a storage system and an existing dashboard.
2. Click **Navigate to Details View**.

   The component's details display. For example, the details view for the storage group, front-end director, or disk group.

   You cannot navigate from any of the dashboards for all components (all arrays, all disk groups, and so on.).

**Analyze view**

The Analyze view provides three views into your storage data. You can use the Real Time Analysis and Root Cause Analysis views to debug and find causes for performance problems. You can use the Trending & Planning view to view historical data, showing long-term trends, to plan for future needs.

**Real Time Analysis view**

The default range is the previous 1 hour. Real Time Analysis view collects data between 2 and 5 seconds for a limited group of metrics. The data is available for the previous hour.

**Root Cause Analysis view**

The default range is the previous 4 hours. Root Cause Analysis view collects data every 5 minutes for root cause analysis. The data is available for the previous 7 days.

**Trending & Planning view**

The default range is the previous 7 days. Trending & Planning view collects data in 15 minute intervals for trending and planning. The data is available for the previous year.

You can use Real Time Analysis and Root Cause Analysis information to debug and find the cause of performance problems. Trending & Planning information shows long-term trends you can use to plan for future requirements.

Licensed and registered storage systems are displayed in a table format.

**Procedure**

1. Do one, or more, of the following:
   
   - To see more information about a storage system, click the ID of the storage system.
     More detailed data, displayed according to category, is presented.
   
   - To navigate between the different categories of information for that storage system, select a category from the drop-down menu in the breadcrumb trail. Categories for which there is no information available for that storage system are not displayed. The detailed information displayed for each storage system depends on the configuration and version of that storage system.
Creating a dashboard from an Analyze view

Before you begin
You require access to a visible, registered storage system.
You can create a dashboard from the information currently displayed in an Analyze view.
To create a dashboard from an Analyze view:

Procedure
1. Select component(s) from the table in an Analyze view, and create one or more charts.
2. Click **Save As > Dashboard**.
   The **Create Dashboard** dialog box displays.
3. Specify a dashboard name and folder.
4. (Optional) Set this dashboard as the default.
   This means that this dashboard displays each time you enter the Monitor view.
   Each user can have only one default dashboard. A storage system heat map is the default until you specify a default dashboard.
5. Click **OK** to save the dashboard.

Creating a template dashboard from an Analyze view

To create a dashboard template from an Analyze view:

Procedure
1. Select component(s) from the table in Analyze view, and create one or more charts. For more information, refer to **Charts View** on page 674.
2. Click **Save as Template**. The **Create Template Dashboard** dialog box opens.
3. Enter a **Dashboard Name**.
4. Select a **Folder** for the dashboard.
5. (Optional) Select the **Instances** to monitor. Not all components have this option.
6. Click **OK** to save the dashboard.
   The dashboard saves to the specified folder in Dashboards view.

Viewing a Real Time trace

Before you begin
You require one or more saved data traces.
You can view saved traces of Real Time data to troubleshoot or diagnose performance issues.
To view a Real Time trace:
Procedure

1. Select **Performance > Monitor**.
2. Click **Analyze**.
3. Select **Real Time Analysis**.
4. Select the storage system.
5. From the time selection drop-down menu, select **Trace**.
   The **Trace Selection** dialog box displays.
6. Click **OK**.

Results

When the trace displays in the table, you can create charts for monitoring that time range.

**Symmetrix systems view (Real Time Analysis)**

The Real Time Analysis view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems. Some or all of the following information is displayed:

- **Host IOs/sec**
  The IOs per second for each front end director.

- **Host MBs/sec**
  The MBs per second for each front end director.

- **FE Reqs/sec**
  The number of requests per second for each front end director.

- **System WP Events/sec**
  The number of write pending events per second for the system.

- **Device WP Events/sec**
  The number of write pending events per second for the volume.

**FE Director view (Real Time Analysis)**

The Real Time Analysis view provides detailed data about front-end directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  The ID of the director.

- **% Busy**
  The percent of time the director is busy.

- **Host IOs/sec**
  The IOs per second for each front end director.

- **Host MBs/sec**
  The MBs per second for each front end director.

- **Reqs/sec**
  The number of requests per second for each front end director.
System WP Events/sec
The number of write pending events per second for the system.

Device WP Events/sec
The number of write pending events per second for the volume.

BE Director (DA) view (Real Time Analysis)
The Real Time Analysis view provides detailed data about back-end directors (DA). The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

% Busy
The percent of time the directory is busy.

IOs/sec
The number of IOs to and from the disks that are mapped to this back-end director.

Reqs/sec
The requests per second for each back-end director.

Reads Reqs/sec
The number of read requests to and from the disks that are mapped to this back-end director.

Writes Reqs/sec
The number of write requests to and from the disks that are mapped to this back-end director.

External Director view (Real Time Analysis)
The Real Time Analysis view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the external director.

% Busy
The percent of time that the director is busy.

IOs/sec
The number of IOs (per second) handled by the director.

Reqs/sec
The average number of requests performed by the director per second.

Read Reqs/sec
The average number of read requests performed by the director per second.

Write Reqs/sec
The average number of write requests performed by the director per second.
**RDF Director view (Real Time Analysis)**

The Real Time Analysis view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  The ID of the director.

- **% Busy**
  The percent of time the director is busy.

- **IOs/sec**
  The number of IOs to and from the disks that are mapped to this RDF director.

- **Tracks Sent/sec**
  The number of tracks sent to each disk from the RDF director.

- **Tracks Received/sec**
  The number tracks received from each disk mapped to the RDF director.

**Symmetrix systems view (Root Cause Analysis)**

The Root Cause Analysis view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems. Some or all of the following information is displayed:

- **Symmetrix ID**
  The Symmetrix ID for each supported system in the domain.

- **Alerts**
  The number and severity of alerts associated with each Symmetrix system.

- **Host IOs/sec**
  The number of host IO operations performed each second by all Symmetrix volumes, including writes and random and sequential reads.

- **Host MBs/sec**
  The number of host MBs written and read by all of the Symmetrix volumes each second.

- **FE Utilization**
  The calculated percent of time the front-end directors are busy.

- **BE Utilization**
  The calculated percent of time the back-end directors are busy.

- **RDF Utilization**
  The calculated percent of time the RDF directors are busy.
  If the utilization value is not available, the number indicates the MBs per second activity between the local and remote Symmetrix systems, if both systems are in the managed domain. If the remote system is not in the domain, the value for each of the local R1 links displays without a remote identifier.
% Cache WP
The percent of cache that is busy with write pendings.

Disk Utilization
The average utilization across the disk groups. The utilization (time busy) values are 0% to 100%.

Average Fall Thru Time
The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.

Alerts view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about alerts. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

Created
The time the alert was created.

Severity
The severity of the alert.
• (1) Fatal
• (2) Critical
• (3) Warning
• (4) Information
• (5) Normal

Category
The object related to the alert, such as volume group, disk group, etc.

Instance
The specific category of the alert. For example, if the category listed disk groups, the instance would name the specific disk.

Metric
The metric that generated the alert.

Value
The specific value of the metric that generated the alert.

Count
The number of times the metric exceeded the threshold.

Acknowledge
Indicates whether the alert has been acknowledged.

Type
Indicates whether the alert is static or dynamic.

Message
Describes the cause of the alert.
**FE Directors view (Root Cause Analysis)**

The Real Time Analysis view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system.

Some or all of the following information is displayed:

- **ID**
  - The ID of the director.

- **% Busy**
  - The percent of time the director is busy.

- **Host IOs/sec**
  - The number of host commands for data transfer per second.

- **Host MBs/sec**
  - The size (MBs) of the host throughput per second.

- **Reqs/sec**
  - The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.

- **System WP Events/sec**
  - The number of write misses due to the system write pending limit having been reached.

- **Device WP Events/sec**
  - The number of write misses due to the volume write pending limit having been reached.

**BE Directors (DA) view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about back-end directors (DA). The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  - The ID of each back end director.

- **% Busy**
  - The percent of time that a director is busy.

- **IOs/sec**
  - The number of IOs (per second) commands to the disk.

- **Reqs/sec**
  - The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter is incremented at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.
MBs Read/sec  
The average size of host MBs read (per second) by the director.

MBs Written/sec  
The average size of host MBs written (per second) by the director.

External Directors view (Root Cause Analysis)  
The Root Cause Analysis view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID  
The ID of each external director.

% Busy  
The percent of time that the director is busy.

I/Os/sec  
The number of I/Os (per second) handled by the director.

Reqs/sec  
The average number of requests performed by the director per second.

MBs Read/sec  
The average number of MBs read by the director per second.

MBs Written/sec  
The average number of MBs written by the director per second.

RDF Directors view (Root Cause Analysis)  
The Root Cause Analysis view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID  
The ID of each RDF director.

% Busy  
The percent of time that a director is busy.

I/Os/sec  
The number of I/Os (per second) handled by the director.

MBs Sent/sec  
The average size of MBs sent (per second) by the director.

MBs Received/sec  
The average size of MBs received (per second) by the director.

Copy I/Os/sec  
The number of copy I/Os (per second) by the director.
Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in
this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1->R2 copy of tracks (due to invalids) is a “copy.”

**Copy MBs/sec**
- The size of copy IOs (per second) by the director.

**% Compressed MBs Sent**
- The percent of total MBs sent by the director that were compressed MBs.

### IM Directors view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about IM directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  - The ID of the IM director.

- **Page In Time**
  -

- **Page Out Time**
  -

### EDS Directors view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about EDS directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  - The ID of each EDS director.

- **Random Read Misses**
  - The number of random read IOs that were misses.

- **Random Read Misses Mbytes**
  -

- **Random Write Misses**
  - The number of random write IOs that were misses.

- **Random Write Misses Mbytes**
  -

### Cache Partitions view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about cache partitions. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  - The cache partition identifier.
% WP Utilization
The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.

% Hit
The Read/Hit and Write/Hit ratio percentage for the cache partition.

% Cache Used
The percent of the cache partition that is used.

Boards view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about boards. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the board.

% Busy
The percent of time the board is busy.

Outbound MBs/sec
-

Inbound MBs/sec
-

Max Speed MBs/sec
-

Disk Technologies view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about disk technologies. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The disk technology identifier.

Name
The disk technology name.

% Busy
The percent of time the disk technology group is busy.

Reads/sec
The average number of host reads performed per second.

MBs Read/sec
The throughput per second for the disks that comprise this disk technology group.

Avg Read Response time (ms)
The average time it took the disk technology group to serve one read command.
**Writes/sec**
The number of write operations performed by the disk technology group per second.

**MBs Written/sec**
The number of write MBs performed by the disk technology group per second.

**Avg Write Response Time (ms)**
The average time it took the disk technology group to serve one write command.

**Total Capacity (GB)**
The total capacity of the disk technology group.

**% Used Capacity**
The used capacity of the disk technology group.

**Members**
The number of members in the disk technology group.

**Model**
The vendor model number of the disk.

---

**Events view (Root Cause Analysis)**
The Root Cause Analysis view provides detailed data about events. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**Sequence Number**
- 

**Timestamp**
- 

**Function Class**
- 

**Action Code**
- 

**Activity ID**
- 

**Message**
- 

**Application ID**
- 

**Host ID**
- 

**Vendor ID**
-
Storage Groups view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name assigned to this storage group.

**Host IOs/sec**
The number of host read IO and write IO operations performed each second by the group.

**Host MBs/sec**
The number MBs performed each second by the group.

**Read Response Time (ms)**
The time it takes the group to perform the Reads in milliseconds.

**Write Response Time (ms)**
The time it takes the group to perform the Writes in milliseconds.

**% Hit**
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

**% Writes**
The percent of IO operations that were writes.

**% Read Miss**
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

**Capacity (GB)**
The capacity of the storage group in GBs.

**Members**
The number of volumes that comprise this storage group.

Device Groups view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about device groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name assigned to the device group.
Host IOs/sec
The number of host operations performed each second by the group.

Read Response Time (ms)
The average time it took the storage system to serve one read IO for this group.

Write Response Time (ms)
The average time that it took the storage system to serve one write IO for this group.

% Hit
The percent of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Capacity (GB)
The capacity of the device group in GBs.

Members
The number of volumes that comprise this device group.

Databases view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about databases. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the database.

Host
-

Env Name
-

Host IOs/sec
Host operations performed each second by the group.

Read Response Time (ms)
The average time that it took the storage system to serve one read IO for this group.

Write Response Time (ms)
The average time that it took the storage system to serve one write IO for this group.
% Hit
Percentage of I/O operations for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.

% Writes
Percentage of IO operations that were writes.

% Read Miss
Percentage of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Allocated Capacity (GB)

Total Capacity (GB)

Members

Thin Pools view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about virtual pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The identifier of the thin pool.

BE Reqs/sec
The number of data transfers between cache and the pool.

BE MBs Transferred/sec
The number of MBs transferred each second between cache and the pool.

BE Avg Response Time (ms)
The average time it takes to transfer IO from pool to cache.

Allocated Pool Capacity (GB)
The allocated capacity for the thin pool in GBs.

Disk Groups view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about disk groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The disk group ID.

Name
The disk group name.

% Busy
The percent of time the disk group is busy.
Reads/sec
The number of read operations performed by the disk group per second.

MBs Read/sec
The number of read MBs performed by the disk group per second.

Avg Read Response Time (ms)
The average time it took the disk group to serve one read command.

Writes/sec
The number of write operations performed by the disk group per second.

MBs Written/sec
The number of write MBs performed by the disk group per second.

Avg Write Response Time (ms)
The average time it took the disk group to serve one write command.

Total Capacity (GB)
The total capacity of the disk group.

Used Capacity (%)
The used capacity of the disk group.

Members
The number of members in the disk group.

Model
The vendor model number of the disk.

External Disk Groups view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about external disk groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The identifier assigned to this external disk group.

Name
The name of the external disk group.

Reads/sec
The average number of host reads performed per second.

MBs Read/sec
The throughput per second for the disks that comprise this disk group.

Avg Read Response Time
The average time it takes the storage system to perform read operations.

Writes/sec
The average number of host writes performed per second.

MBs Written/sec
The number of MBs written per second.
**Avg Write Response Time**

The average time it takes the storage system to perform write operations.

**Total Capacity (GB)**

The total available capacity in GBs for disks in the external disk group.

**% Used Capacity**

The total percentage used capacity in GBs for disks in the external disk group.

**Members**

The number of members in the external disk group.

---

**SRPs view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about SRPs. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  
  The ID of the SRP.

- **Name**
  
  The name of the SRP.

- **Host IOs/sec**
  
  The number of IOs per second transferred from the host.

- **Host MB/sec**
  
  The number of host MBs written and read by all of the storage volumes each second.

- **BE Reqs/sec**
  
  The number of read or write requests performed each second between the cache and the director.

- **BE MBs Transferred/sec**
  
  The MBs transferred per second to the disk directors.

- **Avg Response Time (ms)**
  
  The average time it takes the SRP to service IO.

---

**RDFA Groups view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about RDF/A groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  
  Displays the RDF/A group number.

- **Name**
  
  Displays the RDF/A group name.

- **Host IOs/sec**
  
  The total IOs per second for the RDF/A group.
Duration of Last Cycle
The number of seconds for the last cycle in the session.

RDF R1 to R2 MBs/sec
The throughput in MB per second from the R1 to the R2 for the RDF/A group.

RDF/A WP Count
The number of cache slots in use by the RDF/A group.

Local WP Count
The number of write pending slots waiting to be de-staged to disk. The R1 should be less than or equal to the system write pending count.

DSE Used Tracks
The number of tracks used by DSE for the RDF/A group.

% Compressed MBs Sent
The percent of total MBs sent by the director that were compressed MBs.

RDFS Groups view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about RDF/S groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The RDF/S group number.

Name
The RDF/S group name.

Response Time (ms)
The average time it took the storage system to serve one IO for the RDF/S group.

Host Writes per second
The total host writes per second for the RDF/S group.

% Hit
The percent of read and write operations for this group that were immediately satisfied from cache.

% Write
The percent of IO operations that were writes for the RDF/S group.

Snap Pools view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about snap pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The identifier of the snap pool.
**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Read/sec**
The throughput (MBs) that were reads.

**BE MBs Written/sec**
The throughput (MBs) that were writes.

**BE Disk Read Response Time (ms)**
The calculated back-end disk read response time in milliseconds for the snap pool.

**Allocated Pool Capacity (GB)**
The allocated capacity for the snap pool in GBs.

**Used Pool Capacity (GB)**
The used pool capacity in GBs.

**Members**
The number of volumes in the snap pool.

---

**DSE Pools view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about DSE pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The identifier of the DSE pool.

**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Read/sec**
The number of MBs that were read requests to the disk directors from the disk.

**BE MBs Written/sec**
The number of MBs that were written to the disk directors from the disk.

**BE Disk Read Response Time (ms)**
The calculated response time for read operations on the back end.

**Allocated Pool Capacity (GB)**
The allocated capacity for the DSE pool in GBs.

**Used Pool Capacity (GB)**
The used pool capacity in GBs.

**Members**
The number of volumes in the DSE pool.
FAST VP Policies view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about FAST policies. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
- The policy ID.

**Allocated SG Capacity (GB)**
- The number of GBs of the storage group that are allocated to the FAST policy.

**Total SG Capacity (GB)**
- The total capacity of the storage group.

**Allocated Pool Capacity (GB)**
- The number of GBs of the virtual pool that are allocated to the FAST policy.

**Total Pool Capacity (GB)**
- The total capacity of the virtual pool.

**BE Reqs/sec**
- The number of data transfers between cache and the director.

**BE MBs Transferred/sec**
- The number of MBs transferred each second between cache and the director.

Disk Group Tiers view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about disk group tiers. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
- The name assigned to this storage tier.

**% Busy**
- A high-level overview of the utilization (time busy) for the disks that comprise this storage tier during the selected time range.

**Reads/sec**
- The average number of host reads performed per second.

**MBs Read/sec**
- The throughput in MBs read per second.

**Avg Read Response Time (ms)**
- The average time it takes the storage system to perform the Reads, in milliseconds.

**Writes/sec**
- The average number of host writes performed per second.

**MBs/Written/sec**
- The throughput in MBs written per second.
**Virtual Pool Tiers view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about virtual pool tiers. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  The name assigned to this storage tier.

- **BE Reqs/sec**
  The number of read/write requests each second performed by the disk directors to the cache.

- **BE MBs Transferred/sec**
  The number of MBs per sec + the number of MBs written per second.

- **BE Avg Response Time (ms)**
  The average time it takes to perform IO requests from the disk directors to cache.

- **Allocated Pool capacity (GB)**
  The allocated pool capacity.

**Storage Groups view (Root Cause Analysis)**

The Root Cause Analysis view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  The name assigned to this storage group.

- **Host I/Os/sec**
  The number of host read IO and write IO operations performed each second by the group.

- **Host MBs/sec**
  The number MBs performed each second by the group.

- **Read Response Time (ms)**
  The time it takes the group to perform the Reads in milliseconds.
Write Response Time (ms)
The time it takes the group to perform the Writes in milliseconds.

% Hit
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

Capacity (GB)
The capacity of the storage group in GBs.

Members
The number of volumes that comprise this storage group.

Hosts view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about hosts. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host I/Os/sec
The number of host operations performed each second by the host.

Host MBs/sec
Number of MBs per second being processed for the host.

Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Initiators view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about initiators. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host I/Os/sec
The number of host operations performed each second by the initiator.

Host MBs/sec
Number of MBs per second being processed for the initiator.
Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Masking Views view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about masking views. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host IOs/sec
The number of host operations performed each second by the masking group.

Host MBs/sec
Number of MBs per second being processed for the specific masking group.

Read Response-Time (ms)
The average time it takes to serve one read IO.

Write Response-Time (ms)
The average time it takes to serve one write IO.

Capacity (GB)
The total capacity of the masking group, in GBs.

Port Groups view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about port groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the port group.

% Busy
The percent of time the port group is busy.

Host IOs/sec
The number of host IO operations performed each second, including writes and random and sequential reads.

Host MBs/sec
The number of host MBs read each second.

Host IO Limit Delayed IOs/sec
The sum of the IOs that were delayed due to the port group's IO limits and bandwidth limits.
Host IO Limit by SG view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about host IO limits set for the storage group. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name of the storage group.

**Host IOs/sec**
Number of IOs the FE port is completing for the storage group.

**Read Response-Time (ms)**
The average time it takes to serve one read IO for this storage group.

**Write Response-Time (ms)**
The average time it takes to serve one write IO for this storage group.

**IO Limit % Delayed IOs**
The host IO delayed IOs divided by the IO count.

**IO Limit Avg Delayed Time (ms)**
The time that IOs are delayed (due to the SG’s set IO and bandwidth limits) divided by the count of the IOs delayed (due to the SG’s set IO and bandwidth limits).

**Host IO Limit Delayed IOs/sec**
The host IO delayed IOs per second.

Host IO Limit by FE view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about host IO limits sorted by the front-end director. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name of the director.

**Host IOs/sec**
Number of IOs the FE port is completing for the specific storage group.

**Host IO Limit IOs/sec**
Number of IOs the FE port is completing for the specific storage group.

**Host MBs/sec**
Number of MBs per second being processed for the specific storage group.

**Host IO Limit MBs/sec**
The Host IO delayed IOs divided by the IO count.

**Host IO Limit % Delayed IOs**
The Host IO delayed IOs divided by the IO count.
Symmetrix systems view (Trending & Planning)

The Trending & Planning view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems. Some or all of the following information is displayed:

**Symmetrix ID**
- The Symmetrix ID for each supported system in the domain.

**Alerts**
- The number and severity of alerts associated with each storage system.

**Host I/Os/sec**
- The number of host IO operations performed each second by all volumes, including writes and random and sequential reads.

**Host MBs/sec**
- The number of host MBs written and read by all of the volumes each second.

**FE Utilization**
- The calculated percent of time the front-end directors are busy.

**BE Utilization**
- The calculated percent of time the back-end directors are busy.

**RDF Utilization**
- The calculated percent of time the RDF directors are busy.
  - If the utilization value is not available, the number indicates the MBs per second activity between the local and remote storage systems, if both systems are in the managed domain. If the remote system is not in the domain, the value for each of the local R1 links displays without a remote identifier.

**% Cache WP**
- The percent of cache that is busy with write pendings.

**Disk Utilization**
- The average utilization across the disk groups. The utilization (time busy) values are 0% to 100%.

**Average Fall Thru Time**
- The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.

Alerts view (Trending & Planning)

The Trending & Planning view provides detailed data about alerts. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**Created**
- The time the alert was created.

**Severity**
- The severity of the alert.
  - (1) Fatal
• (2) Critical
• (3) Warning
• (4) Information
• (5) Normal

Category
The object related to the alert, such as volume group, disk group, etc.

Instance
The specific category of the alert. For example, if the category listed disk groups, the instance would name the specific disk.

Metric
The metric that generated the alert.

Value
The specific value of the metric that generated the alert.

Count
The number of times the metric exceeded the threshold.

Acknowledge
Indicates whether the alert has been acknowledged.

Type
Indicates whether the alert is static or dynamic.

Message
Describes the cause of the alert.

FE Directors view (Trending & Planning)
The Trending & Planning view provides detailed data about front-end directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of each front end director.

% Busy
The percent of time the directory is busy.

Host IOs/sec
The number of host commands for data transfer per second.

Host MBs/sec
The size (MBs) of the host throughput per second.

Reqs/sec
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.
System WP Events/sec
The number of write misses due to the system write pending limit having been reached.

Device WP Events/sec
The number of write misses due to the volume write pending limit having been reached.

BE Directors (DA) view (Trending & Planning)
The Trending & Planning view provides detailed data about back-end directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of each back end director.

% Busy
The percent of time that a director is busy.

IOs/sec
The number of IOs (per second) commands to the disk.

Reqs/sec
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter is incremented at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.

MBs Read/sec
The average size of host MBs read (per second) by the director.

MBs Written/sec
The average size of host MBs written (per second) by the director.

External Directors view (Trending & Planning)
The Trending & Planning view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of each external director.

% Busy
The percent of time that the director is busy.

IOs/sec
The number of IOs (per second) handled by the director.

Reqs/sec
The average number of requests performed by the director per second.
MBs Read/sec
The average number of MBs read by the director per second.

MBs Written/sec
The average number of MBs written by the director per second.

**RDF Directors view (Trending & Planning)**

The Trending & Planning view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The ID of each RDF director.

**% Busy**
The percent of time that a director is busy.

**IOs/sec**
The number of IOs (per second) handled by the director.

**MBs Sent/sec**
The average size of MBs sent (per second) by the director.

**MBs Received/sec**
The average size of MBs received (per second) by the director.

**Copy IOs/sec**
The number of copy IOs (per second) by the director.
Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1->R2 copy of tracks (due to invalids) is a “copy.”

**Copy MBs/sec**
The size of copy IOs (per second) by the director.

**% Compressed MBs Sent**
The percent of total MBs sent by the director that were compressed MBs.

**IM Directors view (Trending & Planning)**

The Trending & Planning view provides detailed data about IM directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The ID of the IM director.

**Page In Time**
EDS Directors view (Trending & Planning)

The Trending & Planning view provides the following information about EDS directors:

**ID**
- The ID of each EDS director.

**Random Read Misses**
- The number of random read IOs that were misses.

**Random Read Misses Mbytes**
- 

**Random Write Misses**
- The number of random write IOs that were misses.

**Random Write Misses Mbytes**
- 

Cache Partitions view (Trending & Planning)

The Trending & Planning view provides detailed data about cache partitions. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
- The cache partition identifier.

**% WP Utilization**
- The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.

**% Hit**
- The Read/Hit and Write/Hit ratio percentage for the cache partition.

**% Cache Used**
- The percent of the cache partition that is used.

Boards view (Trending & Planning)

The Trending & Planning view provides detailed data about boards. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
- The ID of the board.

**% Busy**
- The percent of time the board is busy.

**Outbound MBs/sec**
- 

Page Out Time
-
Inbound MBs/sec
- 
Max Speed MBs/sec
- 

**Disk Technologies view (Trending & Planning)**

The Trending & Planning view provides detailed data about disk technologies. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The disk technology identifier.

**Name**
The disk technology name.

**% Busy**
The percent of time the disk technology group is busy.

**Reads/sec**
The average number of host reads performed per second.

**MBs Read/sec**
The throughput per second for the disks that comprise this disk technology group.

**Avg Read Response time (ms)**
The average time it took the disk technology group to serve one read command.

**Writes/sec**
The number of write operations performed by the disk technology group per second.

**MBs Written/sec**
The number of write MBs performed by the disk technology group per second.

**Avg Write Response Time (ms)**
The average time it took the disk technology group to serve one write command.

**Total Capacity (GB)**
The total capacity of the disk technology group.

**% Used Capacity**
The used capacity of the disk technology group.

**Members**
The number of members in the disk technology group.

**Model**
The vendor model number of the disk.
Events view (Trending & Planning)

The Trending & Planning view provides detailed data about events. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **Sequence Number**
- **Timestamp**
- **Function Class**
- **Action Code**
- **Activity ID**
- **Message**
- **Application ID**
- **Host ID**
- **Vendor ID**
- **User name**
- **Offset**

Storage Groups view (Trending & Planning)

The Trending & Planning view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

- **ID**
  - The name assigned to this storage group.

- **Host IOs/sec**
  - The number of host read IO and write IO operations performed each second by the group.

- **Host MBs/sec**
  - The number MBs performed each second by the group.
Read Response Time (ms)
The time it takes the group to perform the Reads in milliseconds.

Write Response Time (ms)
The time it takes the group to perform the Writes in milliseconds.

% Hit
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

Capacity (GB)
The capacity of the storage group in GBs.

Members
The number of volumes that comprise this storage group.

Device Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about device groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name assigned to the device group.

Host I/Os/sec
The number of host operations performed each second by the group.

Read Response Time (ms)
The average time it took the storage system to serve one read IO for this group.

Write Response Time (ms)
The average time that it took the storage system to serve one write IO for this group.

% Hit
The percent of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Capacity (GB)
The capacity of the device group in GBs.
Members
The number of volumes that comprise this device group.

Databases view (Trending & Planning)
The Trending & Planning view provides detailed data about databases. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the database.

Host
-

Env Name
-

Host IOs/sec
Host operations performed each second by the group.

Read Response Time (ms)
The average time that it took the storage system to serve one read IO for this group.

Write Response Time (ms)
The average time that it took the storage system to serve one write IO for this group.

% Hit
Percentage of I/O operations for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.

% Writes
Percentage of IO operations that were writes.

% Read Miss
Percentage of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Allocated Capacity (GB)
-

Total Capacity (GB)
-

Members
-

Thin Pools view (Trending & Planning)
The Trending & Planning view provides detailed data about virtual pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:
ID
The identifier of the thin pool.

BE Reqs/sec
The number of data transfers between cache and the pool.

BE MBs Transferred/sec
The number of MBs transferred each second between cache and the pool.

BE Avg Response Time (ms)
The average time it takes to transfer IO from pool to cache.

Allocated Pool Capacity (GB)
The allocated capacity for the thin pool in GBs.

Disk Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about disk groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The disk group ID.

Name
The disk group name.

% Busy
The percent of time the disk group is busy.

Reads/sec
The number of read operations performed by the disk group per second.

MBs Read/sec
The number of read MBs performed by the disk group per second.

Avg Read Response Time (ms)
The average time it took the disk group to serve one read command.

Writes/sec
The number of write operations performed by the disk group per second.

MBs Written/sec
The number of write MBs performed by the disk group per second.

Avg Write Response Time (ms)
The average time it took the disk group to serve one write command.

Total Capacity (GB)
The total capacity of the disk group.

Used Capacity (%)
The used capacity of the disk group.

Members
The number of members in the disk group.
Model
The vendor model number of the disk.

External Disk Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about external disk groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The identifier assigned to this external disk group.

Name
The name of the external disk group.

Reads/sec
The average number of host reads performed per second.

MBs Read/sec
The throughput per second for the disks that comprise this disk group.

Avg Read Response Time
The average time it takes the storage system to perform read operations.

Writes/sec
The average number of host writes performed per second.

MBs Written/sec
The number of MBs written per second.

Avg Write Response Time
The average time it takes the storage system to perform write operations.

Total Capacity (GB)
The total available capacity in GBs for disks in the external disk group.

% Used Capacity
The total percentage used capacity in GBs for disks in the external disk group.

Members
The number of members in the external disk group.

SRPs view (Trending & Planning)
The Trending & Planning view provides detailed data about SRPs. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the SRP.

Name
The name of the SRP.

Host IOs/sec
The number of IOs per second transferred from the host.
Host MB/sec
The number of host MBs written and read by all of the storage volumes each second.

BE Reqs/sec
The number of read or write requests performed each second between the cache and the director.

BE MBs Transferred/sec
The MBs transferred per second to the disk directors.

Avg Response Time (ms)
The average time it takes the SRP to service IO.

RDFA Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about RDF/A groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
Displays the RDF/A group number.

Name
Displays the RDF/A group name.

Host IOs/sec
The total IOs per second for the RDF/A group.

Duration of Last Cycle
The number of seconds for the last cycle in the session.

RDF R1 to R2 MBs/sec
The throughput in MB per second from the R1 to the R2 for the RDF/A group.

RDF/A WP Count
The number of cache slots in use by the RDF/A group.

Local WP Count
The number of write pending slots waiting to be de-staged to disk. The R1 should be less than or equal to the system write pending count.

DSE Used Tracks
The number of tracks used by DSE for the RDF/A group.

% Compressed MBs Sent
The percent of total MBs sent by the director that were compressed MBs.

RDFS Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about RDF/S groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The RDF/S group number.
**Name**
The RDF/S group name.

**Response Time (ms)**
The average time it took the storage system to serve one IO for the RDF/S group.

**Host Writes per second**
The total host writes per second for the RDF/S group.

**% Hit**
The percent of read and write operations for this group that were immediately satisfied from cache.

**% Write**
The percent of IO operations that were writes for the RDF/S group.

**Snap Pools view (Trending & Planning)**
The Trending & Planning view provides detailed data about snap pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The identifier of the snap pool.

**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Read/sec**
The throughput (MBs) that were reads.

**BE MBs Written/sec**
The throughput (MBs) that were writes.

**BE Disk Read Response Time (ms)**
The calculated back-end disk read response time in milliseconds for the snap pool.

**Allocated Pool Capacity (GB)**
The allocated capacity for the snap pool in GBs.

**Used Pool Capacity (GB)**
The used pool capacity in GBs.

**Members**
The number of volumes in the snap pool.

**DSE Pools view (Trending & Planning)**
The Trending & Planning view provides detailed data about DSE pools. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The identifier of the DSE pool.
BE Reqs/sec
The number of read/write requests each second performed by the disk directors to the cache.

BE MBs Read/sec
The number of MBs that were read requests to the disk directors from the disk.

BE MBs Written/sec
The number of MBs that were written to the disk directors from the disk.

BE Disk Read Response Time (ms)
The calculated response time for read operations on the back end.

Allocated Pool Capacity (GB)
The allocated capacity for the DSE pool in GBs.

Used Pool Capacity (GB)
The used pool capacity in GBs.

Members
The number of volumes in the DSE pool.

FAST VP Policies view (Trending & Planning)
The Trending & Planning view provides detailed data about FAST policies. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The policy ID.

Allocated SG Capacity (GB)
The number of GBs of the storage group that are allocated to the FAST policy.

Total SG Capacity (GB)
The total capacity of the storage group.

Allocated Pool Capacity (GB)
The number of GBs of the virtual pool that are allocated to the FAST policy.

Total Pool Capacity (GB)
The total capacity of the virtual pool.

BE Reqs/sec
The number of data transfers between cache and the director.

BE MBs Transferred/sec
The number of MBs transferred each second between cache and the director.

Disk Group Tiers view (Trending & Planning)
The Trending & Planning view provides detailed data about disk group tiers. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:
The Trending & Planning view provides detailed data about virtual pool tiers. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name assigned to this storage tier.

**% Busy**
A high-level overview of the utilization (time busy) for the disks that comprise this storage tier during the selected time range.

**Reads/sec**
The average number of host reads performed per second.

**MBs Read/sec**
The throughput in MBs read per second.

**Avg Read Response Time (ms)**
The average time it takes the storage system to perform the Reads, in milliseconds.

**Writes/sec**
The average number of host writes performed per second.

**MBs/Written/sec**
The throughput in MBs written per second.

**Avg Write Response Time (ms)**
The average time it takes the storage system to perform the Writes, in milliseconds.

**Total Capacity (GB)**
The total available capacity in GBs for disks that comprise this storage tier.

**% Used Capacity**
The total capacity used in GBs for disks that comprise this storage tier.

**Number of Disks**
The number of members in the tier.

**Technology Protection**
The protection type of the tier.

**Virtual Pool Tiers view (Trending & Planning)**

The Trending & Planning view provides detailed data about virtual pool tiers. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name assigned to this storage tier.

**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Transferred/sec**
The number of MBs per sec + the number of MBs written per second.
BE Avg Response Time (ms)
The average time it takes to perform IO requests from the disk directors to cache.

Allocated Pool capacity (GB)
The allocated pool capacity.

Storage Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The storage group tier ID.

BE Read Reqs/sec
The number of read requests each second performed by the disk director to cache.

Destage Writes/sec
The number of writes per second that were destaged to disk.

IOs/sec
The number of IOs per second for data transfer.

BE MBs Read/sec
The number of host read IOs performed by the disk group per second.

Destage Write MBs/sec
The size (MBs) of writes per second that were destaged to disk.

MBs/sec
The total MBs read and written per second.

Capacity
The allocated capacity.
For example, if SG1 is 100 GB on Tier1 and 50 GB on Tier2, then the SG capacity is 100 GB for Tier1 and 50 GB for Tier2.

IO Density
The number of BE requests per GB of disk.
(BE Reads + destaged writes) / capacity

Hosts view (Trending & Planning)
The Trending & Planning view provides detailed data about hosts. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host IOs/sec
The number of host operations performed each second by the host.
Host MBs/sec
Number of MBs per second being processed for the host.

Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Masking Views view (Trending & Planning)
The Trending & Planning view provides detailed data about masking views. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host IOs/sec
The number of host operations performed each second by the masking group.

Host MBs/sec
Number of MBs per second being processed for the specific masking group.

Read Response-Time (ms)
The average time it takes to serve one read IO.

Write Response-Time (ms)
The average time it takes to serve one write IO.

Capacity (GB)
The total capacity of the masking group, in GBs.

Port Groups view (Trending & Planning)
The Trending & Planning view provides detailed data about port groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The ID of the port group.

% Busy
The percent of time the port group is busy.

Host IOs/sec
The number of host IO operations performed each second, including writes and random and sequential reads.

Host MBs/sec
The number of host MBs read each second.

Host IO Limit Delayed IOs/sec
The sum of the IOs that were delayed due to the port group's IO limits and bandwidth limits.
Host IO Limit by SG view (Trending & Planning)

The Trending & Planning view provides detailed data about host IO limits set for the storage group. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the storage group.

Host IOs/sec
Number of IOs the FE port is completing for the storage group.

Read Response-Time (ms)
The average time it takes to serve one read IO for this storage group.

Write Response-Time (ms)
The average time it takes to serve one write IO for this storage group.

IO Limit % Delayed IOs
The host IO delayed IOs divided by the IO count.

IO Limit Avg Delayed Time (ms)
The time that IOs are delayed (due to the SG’s set IO and bandwidth limits) divided by the count of the IOs delayed (due to the SG’s set IO and bandwidth limits).

Host IO Limit Delayed IOs/sec
The host IO delayed IOs per second.

Host IO Limit by FE view (Trending & Planning)

The Trending & Planning view provides detailed data about host IO limits sorted by the front-end director. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the director.

Host IOs/sec
Number of IOs the FE port is completing for the specific storage group.

Host IO Limit IOs/sec
Number of IOs the FE port is completing for the specific storage group.

Host MBs/sec
Number of MBs per second being processed for the specific storage group.

Host IO Limit MBs/sec
The Host IO delayed MBs divided by the IO count.

Host IO Limit % Delayed IOs
The Host IO delayed IOs divided by the IO count.


Initiators view (Trending & Planning)

The Trending & Planning view provides detailed data about initiators. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host I/Os/sec
The number of host operations performed each second by the initiator.

Host MBs/sec
Number of MBs per second being processed for the initiator.

Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Charts View

The Charts view provides the capability to create user-definable charts. A list of metrics dynamically changes based on your selections in the table. The metrics list can display:

KPI Metrics
Lists the key performance indicators that correspond to the column headings in the current table.

All Metrics
Lists all available metrics for the selected object in the table.

When you select a particular system and/or component for which you want to create a chart, the instances per category are listed in order of how active they are, according to the default KPI displayed in the drop-down menu. The default KPI used depends on the component type but you can select a different KPI, as required.

To create charts:

Procedure

1. Select Performance > Monitor > Charts.
2. Select an appropriate time range for the chart or specify a custom time range.
3. In the Categories & Instances section, select the systems or components for which you want to create a chart. Multi-select is allowed in the table.
4. For some components (for example, Disks and Volumes), you are prompted to narrow the list of displayed components according to filter criteria (for example, disk technology). You can click OK without specifying filter criteria, or you can select filter criteria to apply and then click OK.
5. (Optional) To sort instances by category by a different metric, select a KPI from the drop-down list of KPI metrics available for that category.
6. Select the metric(s) that you want to use from the **KPI Metrics** list or the **All** list. You can select multiple metrics, however, the more you select, the less readable the chart will be.

7. Click the icon of the chart type you want to create. The following options are available:

<table>
<thead>
<tr>
<th>Chart Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time series chart</td>
<td>This chart displays values charted over time.</td>
</tr>
<tr>
<td>Snapshot chart</td>
<td>This chart displays a single average value over time.</td>
</tr>
<tr>
<td>Threshold chart</td>
<td>This chart lists, in a table, any thresholds applicable to the selected metrics.</td>
</tr>
</tbody>
</table>

Each chart has icons for properties (style, format, thresholds), minimization/maximization, delete, and refresh.

8. **(Optional)** Customize the chart. For more information about how to do this, see Customizing charts on page 675.

9. **(Optional)** Customize the Chart view in which the chart is displayed. For more information about how to do this, refer to Customizing the Charts view on page 678.

**Customizing charts**

After you create a chart there several ways to customize that chart.

**Procedure**

1. To customize a chart, do one or more of the following, depending on the options available:
   - Filter the information in the chart (if the Categories & Instances specified for the chart support filtering):
     a. Click the icon to apply filters, or edit existing ones.

     The **Categories & Instances** that support filtering include **Disks** and **Volumes**.

     - Change the time range of the chart:
From the time range menu, select a time range.

- Add a metric to the chart:
  a. Select the metric in the KPI Metrics or All Metrics list.
  b. Click .
- Change the style of the chart:
  a. Click > Chart Style.
  b. Select a chart style.
  The type of chart styles available depend on the metrics selected for the current chart. Some or all of the following chart styles are available:
    - Line
    - Bar
    - Stacked Bar
    - Area
    - Pie
    - Table
- Change the data format of the chart:
  a. Click Data Format. Select one or both of the following:
    - Average — Shows the average metric value for each metric in the table rows, for the session (hour). This is the default.
    - Maximum — Shows the maximum metric value—the high water mark—for each metric in the table rows, for the session (hour).
  Selecting both formats with a multiple-metrics chart can make a chart less readable.
• Change the zoom level of a time series chart:
  a. Do one of the following:
     ▪ To zoom in and see the chart in more detail, click > Zoom > Zoom In.
     ▪ To zoom out and see a larger time interval, click > Zoom > Zoom Out.
     ▪ To view a particular interval in more detail, select the time interval on the graph. The zoom level of the chart automatically adjusts to display only that time interval.
     ▪ To reset the zoom level of a chart, click > Zoom > Reset Zoom.
• Save the chart as an image:
  a. Click > Save as.
  b. Select JPG or PNG.
  c. Specify a file name for the image file.
• Save the chart as a CSV file:
  a. Click > Save as > CSV
  b. Specify a file name for the CSV file.
• Display a trend line on the chart:
  a. To display the Trend Line on a chart, click > Trend Line.
  b. From the Forecast Points menu, select an appropriate number of data points to use for the trend line.
• Display a threshold on the chart (if thresholds have been set for a metric):
  a. Click > Display Thresholds.

Note
Threshold values are not displayed in table charts.

• Maximize the chart:
  a. Click .
• Minimize the chart:
  a. Click .
• Remove the chart:
  a. Click .
• Restore a maximized chart to the default chart size:
  a. Click .
• Restore a minimized chart to the default chart size:
Customizing the Charts view

There are several ways to customize the way that charts are displayed on the Charts view.

**Procedure**

1. Do one, or more, of the following:
   - Save the Charts view as a dashboard:
     a. Click **Save As > Dashboard**.
   - Save the Charts view as a template:
     a. Click **Save As > Template**.
   - Save the Charts view as a JPG image:
     a. Click **Save As > JPG**.
   - Save the Charts view as a PNG image:
     a. Click **Save As > PNG**.
   - Open a JPG image of the Charts view in a new browser tab:
     a. Click **Save As > To Clipboard**.
   - Save the Charts view as a PDF:
     a. Click **Save As > PDF - Charts**.
   - Save the Charts view as a PDF with data included in an additional table:
     a. Click **Save As > PDF - Chart & Data**.
   - Remove all of the charts from the Charts view:
     a. Click **Remove all Charts**.
   - Adjust the number of columns displayed in the Chart view:
     a. From the column icon drop-down menu, select a value.

---

**Note**

This functionality is available only when using Firefox or Chrome web browsers.

---

**Plan View**

The performance projection dashboard displays predicted future data, based on linear projection. You can use the information contained in the projection dashboard to assist when planning and to avoid potential problems.

The following projection dashboards are available:
Array projection dashboard on page 679
Thin pool projection dashboard on page 679

Select the storage system and category for which you want to view a projection dashboard. By default when initially opened, the projection dashboard displays a heatmap with the Array category of the first storage system.

You need a minimum of 10 days of data to produce a projection dashboard. If insufficient data is available, a message stating the number of remaining days before the projection dashboard can be produced is displayed.

Save as — A drop-down menu containing some or all of the following options:
- JPG
- PNG
- PDF Charts
- PDF Chart & Data

For more information about saving dashboards, refer to Saving dashboards and charts on page 811.

Schedule Report — Scheduling performance reports on page 685

Array projection dashboard

The array protection dashboard displays utilization data based on projections calculated over the selected time range.

You can configure the time ranges for the dashboard by selecting an appropriate time range from the drop-down menu. The following time ranges are available:
- Next week
- Next Month
- Next 3 Months
- Next 6 Months

By default, when initially opened, the Utilization Projection dashboard displays heatmap data for the next month.

Click on an element in the array to display a chart for the selected component showing the current utilization values and the projection for the selected time frame.

Thin pool projection dashboard

The Thin pools protection dashboard displays the following charts for the Thin pools in the array:
- All Thin Pools - Capacity Status on page 679
- % Used Capacity Projections on page 680

Note

Changing the time range for the dashboard changes the time range for the % Used Capacity Projections chart only. The All Thin Pools - Capacity Status chart always displays the current data.

All Thin Pools - Capacity Status

This chart displays a table containing current information for all Thin pools in the array. The table contains the following columns:
ID
The ID of the Thin pool.
You can click the ID of the Thin pool to navigate to the Single Thin Pool EMC dashboard in the Monitor view.

Days to Full
The number of days until the capacity of the pool will be fully utilized.
The maximum calculated value is 180 days. One of the following status icons is displayed according to the Days to Full value:

<table>
<thead>
<tr>
<th>Status Icon</th>
<th>Days to Full Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>🕒</td>
<td>&lt; 7 days utilization remaining</td>
</tr>
<tr>
<td>🕒</td>
<td>&lt; 30 days utilization remaining</td>
</tr>
<tr>
<td>🕒</td>
<td>&lt; 90 days utilization remaining</td>
</tr>
<tr>
<td>🕒</td>
<td>&gt; 90 days utilization remaining</td>
</tr>
</tbody>
</table>

Capacity Trend/Month
The capacity growth rate of the Thin pool per month. Arrow icons indicate if the going up, down, or remaining stable.

Capacity
The total capacity of the Thin pool and the percentage currently being used.
By default, the table is sorted by the Days to Full column.

% Used Capacity Projections
This chart displays the current and projected % used capacities for the currently selected Thin pool. When the chart is initially opened, the first Thin pool is displayed, by default.
You can configure the time ranges for this chart by selecting an appropriate time range using the slider control. The following time ranges are available:
* Next week
* Next Month
* Next 3 Months
* Next 6 Months
By default, when initially opened, the % Used Capacity Projections chart displays data for the next week.
Changing the time range for the dashboard changes the time range for this chart only. The % Used Capacity Projections chart always displays current data.

Reports View
To view performance reports:

Procedure
1. Select Performance > Reports to open the Reports list.
Use the Reports list to display and manage reports.
The following properties display:
Name
The user-defined report name.

Symmetrix ID
The storage system identifier.

Format
The report format (XML, CSV, BTP, UPV).

Recurring
Indicates whether the report will run automatically.

Run Date
The date of the report.

Description
The user-defined description.

The following controls are available:
- Create — Creating performance reports on page 681
- Copy — Copying performance reports on page 684
- Edit — Editing performance reports on page 684
- Schedule — Scheduling performance reports on page 685
- Cancel Schedule — Cancelling a scheduled report on page 686
- Run Now — Running performance reports on page 686
- Delete — Deleting performance reports on page 687
- Navigate to Notifications — Configuring alert notifications on page 55

When you click Run Now, you are prompted to choose the location for the generated reports.

Scheduled XML, CSV, and BTP reports are saved to this location:

```
install_dir\SMAS\report\SPA\querydata
```

Note
If the report contains multiple queries involving volumes and disks the report is saved to this location:

```
/SMAS/report/SPA/runnow
```

Scheduled UPV reports are saved to this location:

```
SMAS\backup\SPA
```

Creating performance reports
To create a performance report:
Procedure

1. Select Performance > Reports.
2. Click Create.
3. In the General tab, enter a report Name.
4. (Optional) Enter a report Description.
5. Select the Symmetrix ID.
6. Select a Format
   - XML, CSV, BTP, UPV formats are supported. BTP reports are not available for VMAX3 systems.
7. Select the Time Range.
   - If you select Custom, the Custom Time Selection dialog box displays for custom start and end times.
   - The Last Interval option is available only for the Root Cause Analysis type. This option executes a report on the array and director categories at each Root Cause Analysis interval. In addition, every hour the system runs a cleanup job to remove Last Interval reports that are older than one hour.
   - The BTP format is not available for Last Interval reports.
8. Open the Time Selection calendar to select a data range. Use the Start Time and End Time to make any adjustments, if needed.
9. (Optional) For UPV reports, specify whether to include RT traces.
10. From the Generated Time Zone menu, select the time zone to apply to times in the report. (Not applicable to BTP reports).
11. For XML or CSV reports, add one or more queries to the report. Each of these reports must have at least one query.
    - For more information about creating queries see Creating queries using the Create Query wizard on page 683.

Note

If the report contains multiple queries involving volumes and disks the report is saved to this location:

/SMAS/report/SPA/runnow

12. (Optional) In the Schedule tab, select the Schedule check box and configure values for each of the following options:
    - First Run Time
      - The First Run Time is continually adjusted relative to the current time and the report execution interval. For example, if First Run Time is set to 3am, but the current time is 4am and the Time Range is set to 'Last 4 hours', then the value of First Run Time is changed to 7am.
    - Day(s) to run
    - Retention (Days)
13. (Optional) In the Email tab, specify the report email options.
14. Click OK.
Creating queries using the Create Query wizard

Before you begin

The Create Query wizard is launched from the Create Report dialog box. For more information about creating a report, see Creating performance reports on page 681.

For some categories, you can configure the query to return the $n$ most active instances. This feature is available for the following categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>Storage Group Volumes</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDS Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MB/Sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDA Group</td>
<td>RDF R1 to R2 IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>RDF R1 to R2 MBs/sec</td>
</tr>
<tr>
<td></td>
<td>RDF Response Time</td>
</tr>
<tr>
<td></td>
<td>Host Writes/sec</td>
</tr>
<tr>
<td></td>
<td>Host MBs Written/sec</td>
</tr>
</tbody>
</table>

To create a query using the Create Query wizard:

Procedure

1. When creating a report, in the Create Report dialog box, click Add to open the Create Query wizard.
2. In the Query Name & Description page, enter a query Name.
3. (Optional) Enter a query Description.
4. Click Next.
5. In the Category & Instance page, select a Category.
   Depending on the category type you select, different options are presented.
6. Specify appropriate Instances.
   Some or all of the following options are available:
   - All
     Displays all instances.
   - Specific instances
     Displays the specific instances you select. Select them in the Available list and click > to move them to the Selected list. You can use multi-select for multiple instances.
Most Active
Displays the top $n$ most active instances. You can specify a value for $n$ and the metric by which you want to sort the displayed instances.

7. Click Next.
8. In the Metrics page, select a Data Format. The available options are Average and Maximum.
9. Select the Metrics (for the category and data format you selected on the Category & Instance page of the wizard). You can use multi-select for multiple metrics.
10. Click Finish.

Copying performance reports

Before you begin
Before copying a performance report, you require an existing report in the Reports list view.

To copy a performance report:

Procedure
1. Select Performance > Reports to open the Reports list view.
2. Select a report and click Copy to open the Copy Report dialog box
3. Update the report settings, as appropriate. You can edit the following data:
   - Name
   - Description
   - Symmetrix ID
   - Format
   - Time Range
   - Generated Time Zone
4. In the Queries section, do one of the following:
   - Click Add to open the Create Query wizard and create a query.
   - Select a query and click Delete. Click OK on the confirmation message.
   - Select a query and click Edit to open the Edit Query wizard.
   A report must have at least one query.
5. (Optional) In the Schedule tab, configure the schedule settings for the report.
6. (Optional) In the Email tab, configure the email settings for the report.
7. Click OK.

For more information about reports, see Creating performance reports on page 681

Editing performance reports

Before you begin
Before editing a performance report, you require an existing report in the Reports list view.
To edit a performance report:

**Procedure**
1. Select **Performance > Reports.**
2. Select a report and click **Edit.**
3. Make your changes to the report **Symmetrix ID, Format, Type, Time Range,** and **Description.**
   You cannot change the report name.
4. (Optional) Schedule the report.
5. Select one of the following actions in the **Queries** section:
   - Click **Add** to open the Create Query Wizard and create a new query.
   - Select a query and click **Delete.** Click **OK** in the confirmation dialog box.
   - Edit the query. Complete the following steps:
      - **Note**
      - Reports must have at least one query.
      - a. Select a query and click **Edit** to open the Edit Query wizard.
      - b. Make your changes in each page of the wizard.
      - c. Click **Finish** to close the wizard.
6. Click **OK.**

For more information about reports, refer to Creating performance reports on page 681.

---

**Scheduling performance reports**

**Before you begin**
You must have a configured performance report in the Reports list.

To run a performance report:

**Procedure**
1. Select **Performance > Reports.**
2. Select one or more reports and click **Schedule.**
3. Select the **Schedule** check box.
4. Configure values for each of the following options:
   - **First Run Time**
     The **First Run Time** is continually adjusted relative to the current time and the report execution interval. For example, if **First Run Time** is set to 3am, but the current time is 4am and the **Time Range** is set to 'Last 4 hours', then the value of **First Run Time** is changed to 7am.
   - **Day(s) to run**
   - **Retention (Days)**
5. Click **OK.**
Scheduled XML, CSV, and BTP reports are saved to this location:

SMAS\report\SPA\querydata

**Note**

If the report contains multiple queries involving volumes and disks the report is saved to this location:

/SMAS/report/SPA/runnow

Scheduled UPV reports are saved to this location:

SMAS\backup\SPA

### Cancelling a scheduled report

**Before you begin**

You must have a scheduled performance report in the Reports list view.

To cancel a scheduled report:

**Procedure**

1. Select **Performance > Reports**.
2. Select one or more reports and click **Cancel Schedule**.
3. Click **OK**.

### Running performance reports

**Before you begin**

You require a configured performance report in the Reports list.

To run a performance report:

**Procedure**

1. Select **Performance > Reports**.
2. Select one or more reports and click **Run Now**.
3. Click **OK** on the **Save Report Results** dialog box.
4. Enter a location in the **Save As** dialog box, enter a file name and extension (if necessary), and click **Save**.

The report is saved to the selected location.

**Note**

If the report contains multiple queries involving volumes and disks the report is saved to this location:

/SMAS/report/SPA/runnow
Deleting performance reports

**Before you begin**
You require an existing report in the Reports list view.

To delete performance reports:

**Procedure**
1. Select **Performance > Reports**.
2. Select the report you want to delete and click **Delete**.
3. Click **OK**.

**Settings**

To view system registrations:

**Procedure**
1. Select **Performance > Settings > System Registrations** to open the System Registrations list view.
   
   Use the System Registrations list view to view and manage storage system performance registration and data collection policies.
   
   The following properties display:
   
   - **Symmetrix ID** — The ID of the registered storage system.
   - **Real Time** — An indicator that shows if the storage system is registered for Real Time data.
   - **Root Cause Analysis** — An indicator that shows if the storage system is registered for Root Cause Analysis data.
   - **Collection Recovery (Hours)** — The amount of data that the storstpd daemon will save if the Performance server or the Performance database is not ready to accept new data points. The default is 24 hours.
   - **Root Cause Analysis Interval (Minutes)** — The frequency of polling in the Root Cause Analysis view. The default 5 minutes is recommended.
   - **Server IP** — The IP address of the Unisphere for VMAX server.

   The following controls are available:
   
   - **View Details** — Viewing system registration details on page 687
   - **Register** — Registering storage systems on page 688

**Viewing system registration details**

The system registration details view shows the default values for storage system registrations and data collection settings.

To view system registration details:

**Procedure**
1. Select **Performance > Settings > System Registrations** to open the System Registrations view.
2. Select a Symmetrix ID and click View Details to open its Details view.
   
   The following properties display:
• **Symmetrix ID** — The ID of the registered storage system.

• **Real Time** — An indicator that shows if the storage system is registered for Real Time data.

• **Root Cause Analysis** — An indicator that shows if the storage system is registered for Root Cause Analysis data.

• **Collection Recovery (Hours)** — The amount of data that the `storstpd` daemon will save if the Performance server or the Performance database is not ready to accept new data points. The default is 24 hours.

• **Root Cause Analysis Interval (Minutes)** — The frequency of polling in the Root Cause Analysis view. The default 5 minutes is recommended.

• **Server IP** — The IP address of the Unisphere for VMAX server.

• **SE Server IP** — The IP address of the Solutions Enabler server.

The following controls are available:

• **Apply** — Saves any changes made to the properties.

• **Cancel** — Removes any changes made to the properties and returns the values to the defaults.

---

**Viewing data collection details**

The performance data collection details show the default values for collection recovery and diagnostic interval. These default values can be adjusted.

To view data collection details:

**Procedure**

1. Select **Performance** > **Settings** > **System Registrations** to open the System Registrations view.
2. Select the **Symmetrix ID** from the list of registered systems in the table.
3. Click **View Details**.

**Registering storage systems**

The Performance component of Unisphere for VMAX collects performance data only after you register your storage systems.

Only local storage systems can be registered for performance data collection.

When you register a storage system for performance data collection it takes at least two intervals (by default, 5 minutes each) before performance data begins to populate in the GUI and charts. Before this, the GUI and charts might display "NA" or remain blank.

To register a storage system:

**Procedure**

1. Select the storage system.
2. Click **Performance** > **Settings** > **System Registrations** to open the Systems Registrations view.
3. Click **Register** to open the **Register** dialog box. The Symmetrix ID automatically populates the **Selected Symmetrix(s)** list.
4. Select the type of performance data to collect: **Root Cause Analysis** only, or both **Real Time** and **Root Cause Analysis**.
Removing a system registration

To remove a system registration:

Procedure
1. Select the storage system.
2. Click Performance > Settings > Systems Registrations to open the Systems Registrations view.
3. Select a Symmetrix ID and click View Details to open the system registration details.
4. Clear the registration for Real Time, Root Cause Analysis, or both.
5. Click Apply.

Changing data collection policies

To change collection policies

Procedure
1. Select Performance > Settings > System Registrations to open the System Registrations view.
2. Select the Symmetrix ID from the list of registered systems in the table.
3. Click View Details
4. There are two data collection values that you can change:
   - Collection Recovery (Hours) — The amount of data that the storstpd daemon will save if the Performance server or the Performance database is not ready to accept new data points. The default is 24 hours.
   - Root Cause Analysis Interval (Minutes) — The frequency of polling in the Root Cause Analysis view. The default 5 minutes is recommended.
5. Make your changes and click Apply.

Creating a performance threshold and alert

You can use the default system values for thresholds and alerts, or create your own. When you set threshold values, you can optionally view them when you create charts for performance metrics in the Root Cause Analysis view.

To create a threshold or an alert:

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Click Create.
3. Select the Symmetrix ID, Category, Instance, and Metric.
   For some categories, when selected, the Instance field defaults to All.
   If there is a default value for the Metric, it automatically displays in the First Threshold and Second Threshold fields.
4. Add a value for the First Threshold, Second Threshold, or both.
5. Threshold creation only: Click OK.

6. To add an alert for the threshold, complete the following steps:
   a. Click Enable Alert.
   b. Select the severity for the first threshold, the second threshold, or both. The available values are Information, Warning, and Critical.
   c. Set the number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.
   d. (Optional) Select any additional configuration options. For some group categories, you can choose to enable for the alert for the individual components of the group, for example, when the Disk Group category is selected, you have the option to enable the alert for the disk.
   e. Click OK.

Editing a performance threshold and alert

When you edit a threshold and alert setting, a symbol displays in the Custom column of the alerts list to indicate that the value has changed from the default.

To edit performance thresholds and alerts:

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Navigate to the threshold or alert to be edited by selecting the appropriate category in the Category section and expanding the appropriate metric in the Metric column.
3. Select the item from the table and click Edit.
4. Edit the threshold and alert settings, as appropriate.
5. Click OK.

Deleting performance thresholds and alerts

Before you begin
You can delete only custom values. You cannot delete default thresholds.

To delete a performance threshold and alert:

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Navigate to the threshold or alert to be edited by selecting the appropriate category in the Category section and expanding the appropriate metric in the Metric column.
3. Select one or more rows and click Delete.
4. In the Delete Threshold and Alert confirmation dialog box, click Delete.

Viewing thresholds and alerts

Procedure
1. Select Performance > Settings > Performance Thresholds and Alerts.
2. Select a storage system.
3. In the Category section, select the category for which you want to view the configured thresholds and alerts.

The thresholds and alerts configured for that category are displayed, according to metric. By default, the KPI tab displays. To view all metrics, click All.

Any metrics that include a custom threshold or alert are highlighted with a tick mark in the Custom column.

The following properties display:
- Metric—The storage system identifier.
- KPI—Indicates (with a tick mark) if the metric is a KPI.
- Custom—Indicates (with a tick mark) whether a custom threshold or alert has been set.
- First Threshold—The user-defined first threshold.
- Second Threshold—The user-defined second threshold.

Configuring email notification

You can configure email addresses to which notifications, alerts, and reports are sent. You can configure a single email address for all notification instances, or you can use different email addresses for different notifications on different storage systems.

To set up email notification:

Procedure

1. Do one of the following:
   - To set up email notification:
     - Click Home > Administration > Alert Settings > Notifications.
     - In the Email section, click Enable.
     - In the From section specify the following details:
       - Sender Email
       - IP Address/Host
       - Server Port
     - In the Recipient Email field of the To section, specify the address you want to enable for all email notifications.
     - Click OK.
   - To add an email address and apply it to all notification instances:
     - Click Home > Administration > Alert Settings > Notifications.
     - In the Email section, click Enable.
     - In the Recipient Email field of the To section, specify the address you want to enable for all email notifications.

Note

If you configure a new email address in this way, any previously configured addresses are overwritten.
- Click OK.

- To configure email addresses for individual notifications:
  - Click Home > Administration > Alert Settings > Notifications.
  - Click the Edit icon for the storage system for which you want to edit the email notification settings. The three individual email fields become editable.
  - Configure the email addresses for individual notifications, as appropriate.
  - Optional: Configure the notification levels by clicking the appropriate icons in the System Level and Performance Level columns.
  - Click OK.

Creating a Real Time trace

Before you begin

You must have access to one or more storage systems with Real Time registrations.

A trace is a linear map; in Performance, a trace is one to four hours of real time data that is captured and saved. A trace can be configured in advance. Trace files can be retained up to 30 days.

To create a Real Time trace:

Procedure

1. Select Performance > Settings > Real Time Traces.
2. Click Create.
3. Select the Symmetrix ID.
   
   The storage system IDs display if you are in All Symmetrix mode. If you have already selected a single storage system, this option is read-only.
4. Select the Date and Trace Start Time. Click the calendar icon for the date selection and use the up and down arrows for setting the specific start time.
5. Select the Number of Hourly Traces. You can save up to 4 hours of data in four 1-hour files.
   
   When configuring a new trace, the Status field displays the value New.
6. Select the Retention number of days.
   
   Values are 1–30.
7. (Optional) Enter a Description of this trace.
8. Click OK.

Editing a Real Time Trace

Before you begin

You must have access to licensed storage systems.

There must be a scheduled Real Time Trace showing in the Real Time Traces list. Only scheduled (not yet executed) traces can be modified.

A trace is 1 to 4 hours of real time data that is captured and saved. A trace can be configured in advance. Trace files can be retained up to thirty days.

To edit a trace:
Procedure

1. Select Performance > Settings > Real Time Traces.
2. Select a trace from the list and click Edit.
3. Update the Retention and/or Description values.
   These are the only values that can be changed.
4. Click OK.

Deleting a Real Time trace

Before you begin
You require one or more configured traces in the Real Time Traces list view.

To delete a Real Time trace:

Procedure

1. Select Performance > Settings > Real Time Traces.
2. Select a trace from the list and click Delete.
3. Click OK.

Viewing Real Time traces

A trace is a linear map; in Performance, a trace is one to four hours of real time data
that is captured and saved.

A trace can be configured in advance. Trace files can be retained up to 30 days.

To view a Real Time trace:

Procedure

1. Select Performance > Settings > Real Time Traces.
   Use the Real Time Traces list view to display and manage Real Time traces. The
   list can be for a specific storage system, or all storage systems.
   The following properties display:
   Symmetrix ID
   The storage system identifier.
   Date
   The date of the scheduled trace.
   Trace Time
   The time of the scheduled trace.
   Status
   The status of the scheduled trace. Possible values are:
   New
   The status assigned during creation.
   Scheduled
   The trace has been configured and scheduled to run at a specific time.
   Completed
   The scheduled trace has completed successfully.
No Data
No data was available for the scheduled trace at the time of execution.

Failed
Execution of the trace failed.

Retention (Days)
The number of days for which the trace is saved.

Description
A user-defined description of the trace.

The following controls are available:

- **Create** — *Creating a Real Time trace* on page 692
- **Edit** — *Editing a Real Time Trace* on page 692
- **Delete** — *Deleting a Real Time trace* on page 693

### Viewing databases

**Procedure**

1. Select **Performance > Settings > Databases**.

Use the Databases list view to view and manage databases.

The following properties display:

**Symmetrix ID**
The storage system identifier.

**Status**
The status of the performance database.

**Load Status**
The status of a database action (backup, restore).

**Oldest Trending & Planning Data**
Date and time of the earliest Trending & Planning data.

**Oldest Root Cause Analysis Data**
Date and time of the earliest Root Cause Analysis data.

**Last Backup**
The last backup taken (in days).

**Last Retention**
The last time data was saved (in hours).

**Scheduled Backup**
Time of the scheduled backup.

The following controls are available:

- **Backup** — *Back up a database* on page 695
Backing up a database

The backup database option is available for one or more storage systems, regardless of their registration status. By default, only Trending & Planning (Historical) data is backed up.

To back up the performance database:

**Procedure**

1. Select **Performance > Settings > Databases**.
2. Select a database from the list and click **Backup**.
3. Select the appropriate **Symmetrix ID**.
4. Enter a backup **File Name(s)**
5. (Optional) Select any of the following **Data to Save**:
   - Last day of Diagnostics
   - Named Real Time Traces

---

**Note**

**Historical** is always selected and cannot be unselected.

---

6. Set the **Execution Time**.
   
   Possible values are **Now** and **Schedule** (specific date and time)

   - **Now**—Go to step 7.
   - **Schedule**—Complete the following steps:
     a. Click **Next**.
     b. Select the **Start Date** and time.
     c. Select if you want this to be a **Recurring** database backup.
        If **Yes**, select the days on which the database backups should occur.

7. Click **Finish**.

   A database backup can take some time.
   Also, refer to **Removing database backup files** on page 698.

---

Restoring a database

**Before you begin**

There must be an existing database file.
Restoring a performance database will result in the contents of the current performance database being overwritten. Ensure that you make a backup of the current database, if appropriate to do so.

Do not attempt to restore a database while another restore operation is in progress.

You can restore the performance database of a storage system regardless of whether it is registered.

Procedure
1. Select **Performance > Settings > Databases**.
2. Select a storage system.
3. Click **Restore**.
4. Do one of the following:
   - Select **Restore Diagnostic data if available** if you want to restore Root Cause Analysis (Diagnostic) data.
   - Select **Restore Real Time traces if available** if you want to restore Real Time traces.
5. Click **OK**.

**Viewing database details**

**Before you begin**
You require one or more storage system performance databases.

To view database details:

Procedure
1. Select **Performance > Settings > Databases**.
2. Select a database and click **View Details**.
   
   The following details display:

   **Symmetrix ID**
   The storage system identifier.

   **Registered to Collection**
   Shows the performance views available. Possible values are **Real Time** and **Root Cause Analysis**, or **Not Registered**.

   **Database Administration**
   - **Last backup time**
     Date and time of last backup.
   - **Last restore time**
     Date and time of last restore.
   - **Last aggregation time**
     Last date and time that Trending & Planning data was derived from Root Cause Analysis data.
   - **Last retention time**
     Date and time of last retention.
   - **Last real time retention time**
     Date and time of last Real Time retention.
Trending & Planning

**Oldest available data**
Date and time of first available Trending & Planning data.

**Latest available data**
Date and time of latest Trending & Planning data.

**Set Trending & Planning data retention (months)**
Number of months to save Trending & Planning data. Possible values are 6 to 36 months. This option can be changed. After any change, click **Apply**.

Root Cause Analysis

**Oldest available data**
Date and time of first available Root Cause Analysis data.

**Latest available data**
Date and time of latest Root Cause Analysis data.

**Set Root Cause Analysis data retention (days)**
Number of days to save Diagnostic data. Possible values are 1 to 15 days. This option can be changed, 15 days is the recommended setting. After any change, click **Apply**.

Backup Files

**Set Backup file retention (number of files)**
Number of backup files to save. When this number is exceeded, the oldest file is automatically deleted. This option can be changed. After any change, click **Apply**.

**Number of existing backup files**
Number of existing backup files for this database.

Scheduled Backup Execution Options

**Next Backup**
Displays the date/time for the next scheduled backup (if any).

**Recurring**
Displays the days (Monday, Tuesday, etc) set for a recurring backup.

**Last Day of Root Cause Analysis**
Indicates whether the last day of Root Cause Analysis statistics will be included in the next database backup.

**Named Real Time Traces**
Indicates whether any named real time traces will be included in the next database backup.

The following controls are available:

- **Apply** — Saves any changes made to database details.
Canceling a scheduled database backup

Before you begin
There must be one or more database backups scheduled for a future time.

To cancel a scheduled database backup:

Procedure
1. Select Performance > Settings > Databases.
2. Select a database and click Cancel Schedule.
3. Click OK.

Deleting databases

Before you begin
You require one or more storage systems that are no longer registered and have a performance database.

The database delete action can only be performed on storage systems that are not registered. The delete action removes all references to the storage systems in the master database and removes the data. Backup files are not removed.

To delete a performance database:

Procedure
1. Select Performance > Settings > Databases.
2. Select a database from the list and click Delete Database.
3. Select the data you want to delete.
   The following options are available:
   - Delete database only
   - Delete database & backup files
   - Delete database & backup files and cancel scheduled tasks
4. Click OK.

Removing database backup files

This procedure is for removing unneeded database backup files.

To delete database backup files:

Procedure
1. Select a storage system.
2. Select Performance > Settings > Databases.
3. Select a database and click Remove Backup Files.
4. Select the file(s) to delete from the list of backup files and click OK.

Viewing metrics

To view metrics:
**Procedure**

1. Select **Performance > Settings > Metrics**.
2. Select a metric category from the **Category** menu.

   You can filter the list of displayed metrics. For more information about filtering, refer to **Filtering performance data** on page 809.

   The following properties display:
   - **Metric**
     - The ID of the performance metric.
   - **KPI**
     - An indicator that shows if the metric is a KPI.

   The following controls are available:
   - **Save** — **Editing metrics** on page 699
   - **Restore Defaults** — Restores the default metric settings for the selected category.

---

**Editing metrics**

You can edit metrics to set, or unset, them as KPIs. When a metric is not set as a KPI, it can be viewed under **All** in the Charts view.

To edit metrics:

**Procedure**

1. Select **Performance > Settings > Metrics**.
2. Select a metric category from the **Category** menu.
3. Do one of the following:
   - **Edit the KPI status of one or more metrics**:
     a. Select or clear the **KPI** checkbox.
     b. Click **Save**.
   - **Click Restore Defaults** to restore default metric settings for all metrics in the selected category.

---

**Metrics**

The following table lists all metrics that are available for arrays.

**Table 9 Array metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second by all volumes, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>Version WP Count</td>
<td></td>
</tr>
<tr>
<td>Total Number of R1 Sessions</td>
<td></td>
</tr>
</tbody>
</table>
Table 9 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of R1 Msc Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Cache Slots in Use</td>
<td></td>
</tr>
<tr>
<td>Total Number of R2 Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R1 Msc Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Msc Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R1 Cache Slots in Use</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Msc Sessions</td>
<td></td>
</tr>
<tr>
<td>RDF/A WP Count</td>
<td>The number of RDF/A writes pending.</td>
</tr>
<tr>
<td>Number of R2 Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Total Number of RDF Sessions</td>
<td></td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by all volumes.</td>
</tr>
<tr>
<td>Number of R1 Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by all volumes.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs written and read by all of the volumes each second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The number of host MBs written and read by all of the volumes each second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The number of host MBs written by all of the volumes each second.</td>
</tr>
<tr>
<td>FE Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of total read IO operations performed each second by all of the volumes.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of total write IO operations performed by all of the volumes.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations performed by all of the volumes, for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.</td>
</tr>
</tbody>
</table>
Table 9 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE Read Reqs/sec</td>
<td>A read data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>FE Write Reqs/sec</td>
<td>A write data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>BE IOs/sec</td>
<td>The total IO from all BE directors to the disks per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>A data transfer of a read or write between the cache and the director.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>A data transfer of a read between the cache and the director.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>System WP Events/sec</td>
<td>The number of times each second that write activity was heavy enough to use up the system limit set for write tracks occupying cache. When the limit is reached, writes are deferred until data in cache is written to disk.</td>
</tr>
<tr>
<td>Device WP Events/sec</td>
<td>The number of times each second that the write-pending limit for a specific volume was reached.</td>
</tr>
<tr>
<td>System WP Count</td>
<td>The number of system cache slots that are write pending.</td>
</tr>
<tr>
<td>System Max WP Limit</td>
<td>The percent of the target % at which writes are delayed. The range is from 40% to 80%.</td>
</tr>
<tr>
<td>% Cache WP</td>
<td>The percent of system cache that is write pending.</td>
</tr>
<tr>
<td>Avg Fall Thru Time</td>
<td>The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.</td>
</tr>
<tr>
<td>FE Hit Reqs/sec</td>
<td>The total requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>FE Read Hit Reqs/sec</td>
<td>The total read requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>FE Write Hit Reqs/sec</td>
<td>The total write requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>FE Read Miss Reqs/sec</td>
<td>The total read requests from all front-end directors per second that were misses. A miss occurs when the requested data is not in cache.</td>
</tr>
</tbody>
</table>
Table 9 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE Write Miss Reqs/sec</td>
<td>The total write requests from all front-end directors per second that were misses. A miss occurs when the write had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>FE Balance</td>
<td>Balance information for FE. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>Cache Balance</td>
<td>Balance information for cache. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>SATA Balance</td>
<td>Balance information for SATA. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>FC Balance</td>
<td>Balance information for FC. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>EFD Balance</td>
<td>Balance information for EFD. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>DX Balance</td>
<td>Balance information for DX. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>Queue Depth Utilization</td>
<td>A weighted sum of the utilizations according to the number of IOs in each bucket. Queue depth range metrics are used in the calculation. Calculation: $S_x = 1 - 0.9 \left[ \frac{\text{Avg Queue Depth Range } X - 1}{\text{Avg Queue Depth Range } X} \right] \times \left( \frac{\text{Queue Depth Count Range } X}{\text{Queue Depth Count Total}} \right) \times 100$</td>
</tr>
</tbody>
</table>
Table 9 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA Balance</td>
<td>Balance information for DA. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated array capacity.</td>
</tr>
<tr>
<td>Critical Alert Count</td>
<td>Number of critical alerts.</td>
</tr>
<tr>
<td>Warning Alert Count</td>
<td>Number of warning alerts.</td>
</tr>
<tr>
<td>Information Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Disk Utilization</td>
<td>Percentage of time the disk is busy.</td>
</tr>
<tr>
<td>RDF Utilization</td>
<td>Percentage of time RDF is busy.</td>
</tr>
<tr>
<td>BE Utilization</td>
<td>Percentage of time the BE is busy.</td>
</tr>
<tr>
<td>FE Utilization</td>
<td>Percentage of time the FE is busy.</td>
</tr>
<tr>
<td>Copy Slot Count</td>
<td></td>
</tr>
<tr>
<td>Overall Efficiency Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td>RDF Balance</td>
<td>Balance information for RDF. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>% Snapshot Saved</td>
<td>Percentage savings of the sum of all TDEV Snapshot sizes (at the time of Snapshot creation) and the TDEV Snapshot Allocated Storage.</td>
</tr>
<tr>
<td>% Virtual Provisioning Saved</td>
<td>Percentage savings of the TDEV configured storage presented to the hosts and the TDEV Allocated Storage.</td>
</tr>
<tr>
<td>Snapshot Compression Ratio</td>
<td>Ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).</td>
</tr>
</tbody>
</table>

Note
Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.

| Snapshot Efficiency Ratio | Ratio of the sum of all snapshot sizes and the RDP Logical Backend Storage.                                                                 |

---

Performance Management
### Table 9 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Snapshot Shared Ratio</strong></td>
<td>Ratio of the Snapshot Allocated Storage and the RDP Logical Backend Storage. Sum of all modified tracks on all snapshots / Sum of the RDP size for all snapshot.</td>
</tr>
<tr>
<td><strong>Virtual Provisioning Compression Ratio</strong></td>
<td>Ratio of the TDEV Logical Backend Storage (calculated based on the 128K track size) and the TDEV Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td><strong>Virtual Provisioning Efficiency Ratio</strong></td>
<td>Ratio of the TDEV configured storage and the TDEV Logical Backend Storage (calculated based on TDEV allocated tracks without shared unowned).</td>
</tr>
<tr>
<td><strong>Virtual Provisioning Shared Ratio</strong></td>
<td>Ratio of the TDEV allocated storage and the TDEV Logical Backend Storage. Backend Storage is the sum of TDEV allocated tracks without counting the TDEV shared unowned tracks.</td>
</tr>
<tr>
<td><strong>Overall Compression Ratio</strong></td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td><strong>% Subscribed Capacity</strong></td>
<td>The subscribed capacity as a percentage of the usable capacity.</td>
</tr>
<tr>
<td><strong>% Effective Used Capacity</strong></td>
<td>The percentage of usable capacity that would be used if all compressible data was compressed.</td>
</tr>
<tr>
<td><strong>Usable Capacity GB</strong></td>
<td>The total capacity of all Storage Resource Pools (SRP) in GB.</td>
</tr>
<tr>
<td><strong>% Metadata Replication Used</strong></td>
<td>The percentage of metadata used for replication.</td>
</tr>
<tr>
<td><strong>% Metadata System Used</strong></td>
<td>The percentage of metadata used for the system.</td>
</tr>
</tbody>
</table>

### BE Director (DA) metrics

The following table lists all metrics that are available for back-end directors.
<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of IOs performed each second by the director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter increments at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A data transfer of a read between the director and the cache.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of the total requests.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of the total requests.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time spent processing all system calls.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent using RDF to a remote system.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks pre-fetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Clone Copy Read</td>
<td></td>
</tr>
<tr>
<td>Clone Copy Write</td>
<td></td>
</tr>
<tr>
<td>PHCO Rebuild Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Optimized Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Read</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
Table 10 BE director (DA) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressed Read Reqs/sec</td>
<td>The number of compressed read requests per second.</td>
</tr>
<tr>
<td>Compressed Write Reqs/sec</td>
<td>The number of compressed write requests per second.</td>
</tr>
<tr>
<td>% Compressed Read Reqs</td>
<td>The percentage of read requests that are compressed.</td>
</tr>
<tr>
<td>% Compressed Write Reqs</td>
<td>The percentage of write requests that are compressed.</td>
</tr>
<tr>
<td>Compressed Read MBs/sec</td>
<td>The size of compressed read MBs per second.</td>
</tr>
<tr>
<td>Compressed Write MBs/sec</td>
<td>The size of compressed write MBs per second.</td>
</tr>
<tr>
<td>Compressed MBs/sec</td>
<td>The total size of compressed MBs (read and write) per second.</td>
</tr>
<tr>
<td>Compressed Reqs/sec</td>
<td>The total number of compressed requests (read and write) per second.</td>
</tr>
<tr>
<td>% Compressed Reqs</td>
<td>The total percent of all read and write requests.</td>
</tr>
<tr>
<td>% Compressed Read MBs</td>
<td>The percent of all compressed MBs that were read requests.</td>
</tr>
<tr>
<td>% Compressed Write MBs</td>
<td>The percent of all compressed MBs that were write requests.</td>
</tr>
<tr>
<td>% Compressed MBs</td>
<td>The total percent of all read and write compressed MBs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle Logical Core 0</td>
<td>The percent of time that core 0 is idle.</td>
</tr>
<tr>
<td>% Idle Logical Core 1</td>
<td>The percent of time that core 1 is idle.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy</td>
<td>The percent of time the director was busy with non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
</tbody>
</table>
BE Emulation metrics

The following table lists all metrics that are available for back-end emulation.

**Table 11 BE emulation metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
</tbody>
</table>

BE Port metrics

The following table lists all metrics that are available for back-end ports.

**Table 12 BE port metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed each second by the port.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed each second by the port.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the port.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed</td>
<td>Total port capacity. Note that in the REST API, for backward compatibility reasons, this metric is named <strong>Max Speed Gb/sec</strong>.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

Board metrics

The following table lists all metrics that are available for boards.

The measurements reflect the transfer rate to and from BOSCO compared with the maximum bandwidth.

Utilization, as well as inbound and outbound speed, are measured across all processors, regardless of type.
Table 13 Board metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outbound MBs/sec</td>
<td>Outbound speed.</td>
</tr>
<tr>
<td>Inbound MBs/sec</td>
<td>Inbound speed.</td>
</tr>
<tr>
<td>Max Speed MBs/sec</td>
<td>Maximum speed.</td>
</tr>
<tr>
<td>Utilization</td>
<td>Calculated value: ((\text{transfer-rate-in} + \text{transfer-rate-out}) / \text{max-transfer-rate})</td>
</tr>
</tbody>
</table>

Cache Partition metrics

The following table lists all metrics that are available for cache partitions.

Table 14 Cache partition metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired Slot Count</td>
<td></td>
</tr>
<tr>
<td>Age Non WP Slots</td>
<td></td>
</tr>
<tr>
<td>Avg Age Given Destage</td>
<td></td>
</tr>
<tr>
<td>Avg Age of Write to Non WP Slot</td>
<td>((\text{age non wp slots}) / ((\text{writes to all non wp slots}) - (\text{writes to young non wp slots})))</td>
</tr>
<tr>
<td>Cache Age GT 10 Min</td>
<td></td>
</tr>
<tr>
<td>Cache Age GT 1 hour</td>
<td></td>
</tr>
<tr>
<td>Cache Age GT 1 Min</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 1</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 2</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 3</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 4</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 5</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 6</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 7</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 8</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 1</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 2</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 3</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 4</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 5</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 6</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 7</td>
<td></td>
</tr>
</tbody>
</table>
### Table 14 Cache partition metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache Slot Ages 8</td>
<td></td>
</tr>
<tr>
<td>Cache Slots Used</td>
<td></td>
</tr>
<tr>
<td>Destage Slot Age</td>
<td></td>
</tr>
<tr>
<td>Destaged Slot Count</td>
<td></td>
</tr>
<tr>
<td>Donation Give Count</td>
<td></td>
</tr>
<tr>
<td>Donation Take Count</td>
<td></td>
</tr>
<tr>
<td>Donation Time</td>
<td></td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>Host operations performed each second by the cache partition.</td>
</tr>
<tr>
<td>Local WP Count</td>
<td>The number of write pending slots waiting to be de-staged to disk on the local system. The value should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>% Max Cache</td>
<td>Maximum slot allocation for a partition.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs written and read each second.</td>
</tr>
<tr>
<td>% Min Cache</td>
<td>Minimum slot allocation for a partition</td>
</tr>
<tr>
<td>% WP Utilization</td>
<td>The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Remote WP count</td>
<td>The number of write pending slots waiting to be de-staged to disk on the remote system. The value should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>% Cache Used</td>
<td>The percent of the cache partition that is used.</td>
</tr>
<tr>
<td>% Target Cache</td>
<td>Percent of total cache allocated to this partition.</td>
</tr>
<tr>
<td>Total Replace Slots</td>
<td></td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of cache partition slots that are write pending.</td>
</tr>
<tr>
<td>WP Limit</td>
<td>The maximum number of write-pending slots.</td>
</tr>
<tr>
<td>Writes to All Non WP Slots</td>
<td></td>
</tr>
<tr>
<td>Writes to Young Non WP Slots</td>
<td></td>
</tr>
</tbody>
</table>
# DATA Volume metrics

The following table lists all metrics that are available for DATA volumes.

**Table 15 DATA volume metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated volume capacity.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the volume each second.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the volume from the disk director each second.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk director to the cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
Table 15 DATA volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume (GBs).</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
</tbody>
</table>

Database metrics

The following table lists all metrics that are available for databases.

Table 16 Database metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>Host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>Host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td>Total RDF writes per second for the database.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>Host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>Host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>Host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>Host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>Host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>Host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>Cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>Cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>Cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>Number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>Number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>Number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Kbytes written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the system to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the system to serve one write command.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the group. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the group. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>Percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>Percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations performed that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations performed that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed, a miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percentage of write miss operations performed, a miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
</tbody>
</table>
Table 16 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100* (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
</tbody>
</table>
Table 16 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Write RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Read RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Skew</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 0 to 1</td>
<td></td>
</tr>
</tbody>
</table>
Table 16 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Information Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Critical Alert Count</td>
<td>Number of critical alerts.</td>
</tr>
<tr>
<td>Warning Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated database capacity.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The KBs of back-end IO that were partial sector writes.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
Table 16 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads For Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

Database by Pool metrics

The following table lists all metrics that are available for databases by pool.

Table 17 Database by pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The allocated pool capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) /allocated capacity. With FAST moving active extents to higher tiers, this metric is a good indication of</td>
</tr>
</tbody>
</table>
### Table 17 Database by pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The number of allocated tracks in the database by pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the database by pool.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
</tbody>
</table>

### Device Group metrics

The following table lists all metrics that are available for device groups.

**Table 18 Device group metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td>Total RDF writes per second for the device group.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read IO for this group.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write IO for this group.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write miss IO for this group.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>Number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>Number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>Number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>Number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>Number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>Number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>Number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
</tbody>
</table>
Table 18 Device group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value:100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec/total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100*(seq writes per sec/total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric</td>
</tr>
</tbody>
</table>
### Table 18 Device group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the device group.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the device group.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

### Disk metrics

The following table lists all metrics that are available for disks.

### Table 19 Disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
</tbody>
</table>
Table 19 Disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the Symmetrix disk each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of host read and write requests for the disk.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the disk per second.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Avg Hypers per Seek</td>
<td>The average number of hypervolumes that the disk head crossed during one seek.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk that is used.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
</tbody>
</table>

Disk Bucket metrics

The following table lists all metrics that are available for disk buckets.
### Table 20 Disk bucket metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent busy of disks in this bucket.</td>
</tr>
<tr>
<td>Avg IOs/sec</td>
<td>The average number of disk IOs of disks in this bucket.</td>
</tr>
<tr>
<td>Avg MBs/sec</td>
<td>The average number of disk MBs read and written to disks in this bucket.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>As an IO enters the queue it first checks how deep the queue is. After incrementing the queue depth bucket, it increments the associated count bucket by 1. This then represents the number of IOs that encountered queues of certain depth during the past time interval. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The weighted average response time (read + writes) for disks in this bucket.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of disks in this bucket.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The used capacity of disks in this bucket.</td>
</tr>
<tr>
<td>Avg Number of Disks</td>
<td>The average number of disks in this bucket.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The average number of disk Reads of disks in this bucket.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of disk Writes of disks in this bucket.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The average number of MBs read from disks in this bucket.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The average number of MBs written to disks in this bucket.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average read response time.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average write response time.</td>
</tr>
</tbody>
</table>

### Disk Group metrics

The following table lists all metrics that are available for disk groups.

#### Table 21 Disk group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
</tbody>
</table>
Table 21 Disk group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOs/sec</td>
<td>The number of IO commands to the disk.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The average throughput of host MBs read (per second) by the director.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The average throughput of host MBs written (per second) by the director.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk each second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
</tbody>
</table>

**Disk Group tier metrics**

The following table lists all metrics that are available for disk group tiers.

Table 22 Disk group tier metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk group is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk group each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
</tbody>
</table>
**Table 22 Disk group tier metrics (continued)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it took the disk group to service IOs.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity (in GB) of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity (in GB) allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk group capacity that is free.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) /allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
</tbody>
</table>

**Disk Technology metrics**

The following table lists all metrics that are available for disk technologies.
Table 23 Disk technology metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk group is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk group each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it took the disk group to service IOs.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Seek Distance/sec</td>
<td>The number of hypervolumes that the disk head crossed (during all seeks) each second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity (in GB) of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity (in GB) allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk group capacity that is free.</td>
</tr>
</tbody>
</table>
### Table 23 Disk technology metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. [(BE \text{ Reads} + BE \text{ Writes}) / \text{allocated capacity}] With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
</tbody>
</table>

### DSE Pool metrics

The following table lists all metrics that are available for DSE pools.

#### Table 24 DSE pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: ((\text{MBs read per sec} + \text{MBs written per sec}))</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a read request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools total capacity that is used.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
</tbody>
</table>
### DX Emulation metrics

The following table lists all metrics that are available for DX emulations.

**Table 25 DX emulation metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

### DX Port metrics

The following table lists all metrics that are available for DX ports.

**Table 26 DX port metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td></td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td></td>
</tr>
</tbody>
</table>

### EDS Director metrics

The following table lists all metrics that are available for EDS directors.

**Table 27 EDS director metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Read Misses</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Read Misses Mbytes</td>
<td>The number of random read IOs that were misses in MBs.</td>
</tr>
<tr>
<td>Random Write Misses</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses Mbytes</td>
<td>The number of random write IOs that were misses in MBs.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
</tbody>
</table>
EDS Emulation metrics

The following table lists all metrics that are available for EDS emulations.

Table 28 EDS director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

External Director metrics

The following table lists all metrics that are available for external directors.

Table 29 External director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of IOs performed each second by the director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter increments at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A data transfer of a read between the director and the cache.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of the total requests.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of the total requests.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time spent processing all system calls.</td>
</tr>
</tbody>
</table>
Table 29 External director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent using RDF to a remote system.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks pre-fetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Clone Copy Read</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Clone Copy Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Optimized Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Read</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Compressed Read Reqs/sec</td>
<td>The number of compressed read requests per second.</td>
</tr>
<tr>
<td>Compressed Write Reqs/sec</td>
<td>The number of compressed write requests per second.</td>
</tr>
<tr>
<td>% Compressed Read Reqs</td>
<td>The percentage of read requests that are compressed.</td>
</tr>
<tr>
<td>% Compressed Write Reqs</td>
<td>The percentage of write requests that are compressed.</td>
</tr>
<tr>
<td>Compressed Read MBs/sec</td>
<td>The size of compressed read MBs per second.</td>
</tr>
<tr>
<td>Compressed Write MBs/sec</td>
<td>The size of compressed write MBs per second.</td>
</tr>
<tr>
<td>Compressed MBs/sec</td>
<td>The total size of compressed MBs (read and write) per second.</td>
</tr>
<tr>
<td>Compressed Reqs/sec</td>
<td>The total number of compressed requests (read and write) per second.</td>
</tr>
<tr>
<td>% Compressed Reqs</td>
<td>The total percent of all read and write requests.</td>
</tr>
<tr>
<td>% Compressed Read MBs</td>
<td>The percent of all compressed MBs that were read requests.</td>
</tr>
<tr>
<td>% Compressed Write MBs</td>
<td>The percent of all compressed MBs that were write requests.</td>
</tr>
<tr>
<td>% Compressed MBs</td>
<td>The total percent of all read and write compressed MBs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls.</td>
</tr>
</tbody>
</table>
Table 29 External director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle Logical Core 0</td>
<td>The percent of time that core 0 is idle.</td>
</tr>
<tr>
<td>% Idle Logical Core 1</td>
<td>The percent of time that core 1 is idle.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy</td>
<td>The percent of time the director was busy with non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
</tbody>
</table>

External Disk metrics

The following table lists all metrics that are available for external disks.

Table 30 External disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the external disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the external disk.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the external disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the external disk per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a</td>
</tr>
</tbody>
</table>
### Table 30 External disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>single write</td>
<td></td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the external disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the external disk to serve one write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the external disk per second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second for the external disk.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the external disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The used capacity of the external disk (GBs).</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the external disk that is used.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the disk is busy.</td>
</tr>
</tbody>
</table>

### External Disk Group metrics

The following table lists all metrics that are available for external disk groups.
Table 31 External disk group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the disk group is busy.</td>
</tr>
<tr>
<td>Members</td>
<td>The number of members in the external disk group.</td>
</tr>
</tbody>
</table>

**FAST VP Policy metrics**

The following table lists all metrics that are available for FAST VP policies.
Table 32 FAST VP policy metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated SG Capacity (GB)</td>
<td>The number of GBs of the storage group that are allocated to the FAST VP policy.</td>
</tr>
<tr>
<td>Total SG Capacity (GB)</td>
<td>The total capacity of the storage group.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The number of GBs of the virtual pool that are allocated to the FAST policy.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total capacity of the virtual pool.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of data requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs transferred each second between cache and the director.</td>
</tr>
<tr>
<td>Allocated SG OOP Capacity (GB)</td>
<td>The GBs in the storage group that currently do not reside on the tiers defined in the FAST VP policy.</td>
</tr>
<tr>
<td>% Used Capacity (GB)</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
</tbody>
</table>

FE Director metrics

The following table lists all metrics that are available for FE directors.

Table 33 FE director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>Data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A read data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A write data transfer between the director and the cache. An IO may require multiple</td>
</tr>
</tbody>
</table>
### Table 33 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Read RT (ms)</strong></td>
<td>The calculated average response time for reads.</td>
</tr>
<tr>
<td><strong>Write RT (ms)</strong></td>
<td>The calculated average response time for writes.</td>
</tr>
<tr>
<td><strong>Hits Reqs/sec</strong></td>
<td>A request that is immediately serviced from the cache (instead of having to wait for the data to arrive, or destage from the disk).</td>
</tr>
<tr>
<td><strong>Read Hit Reqs/sec</strong></td>
<td>A read request that is immediately serviced from the cache (instead of having to wait for the data to arrive from the disk.)</td>
</tr>
<tr>
<td><strong>Write Hit Reqs/sec</strong></td>
<td>A write request that is immediately serviced from the cache (instead of having to wait for the data to be destaged to the disk.)</td>
</tr>
<tr>
<td><strong>Miss Reqs/sec</strong></td>
<td>A request that is a miss.</td>
</tr>
<tr>
<td><strong>Read Miss Reqs/sec</strong></td>
<td>A read request that cannot be satisfied immediately from the cache and needs to wait for the data to arrive from the disk.</td>
</tr>
<tr>
<td><strong>Write Miss Reqs/sec</strong></td>
<td>A write request that cannot be satisfied immediately from the cache and needs to wait for the data to be destaged to the disk.</td>
</tr>
<tr>
<td><strong>% Read Reqs</strong></td>
<td>The percent of read requests out of host commands for data transfer.</td>
</tr>
<tr>
<td><strong>% Write Reqs</strong></td>
<td>The percent of write requests out of host commands for data transfer.</td>
</tr>
<tr>
<td><strong>% Hit Reqs</strong></td>
<td>The percent of requests that are served from cache.</td>
</tr>
<tr>
<td><strong>% Read Req Hit</strong></td>
<td>The percent of read requests that are served from cache.</td>
</tr>
<tr>
<td><strong>System WP Events/sec</strong></td>
<td>A write miss due to the system write pending limit having been reached.</td>
</tr>
<tr>
<td><strong>Device WP Events/sec</strong></td>
<td>A write miss due to the volume write pending limit having been reached.</td>
</tr>
<tr>
<td><strong>Syscall Count/sec</strong></td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td><strong>Avg Time per Syscall</strong></td>
<td>The average time that it took to serve one system call.</td>
</tr>
<tr>
<td><strong>Syscall Remote Dir Count/sec</strong></td>
<td>The number of calls per second sent from the local director to another director in the same system.</td>
</tr>
</tbody>
</table>
Table 33 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls per second sent via RDF to a remote system.</td>
</tr>
<tr>
<td>Slot Collisions/sec</td>
<td>The number of write misses due to the desired cache slot being locked by another request.</td>
</tr>
<tr>
<td>Queue Depth Count Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. After incrementing the queue depth bucket, it increments the associated count bucket by 1. This then represents the number of IOs that encountered queues of certain depth during the past time interval. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>Avg Queue Depth Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. Based on depth, the applicable queue depth bucket increments with the value seen by the IO. For example, an IO that encounters a queue depth of 7 will increment bucket #2 (depth 5-9 for OS or 7-14 for MF) by 7. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls.</td>
</tr>
<tr>
<td>Avg RDF Write Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg WP Disconnect Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg Read Miss Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Write Req Hit</td>
<td>The percent of write requests that were satisfied from cache.</td>
</tr>
<tr>
<td>Read RT Count Range 0 to Read RT Count Range Over 64</td>
<td>These buckets show the distribution of the number of reads to the FE directors over the specified time range.</td>
</tr>
</tbody>
</table>
Table 33 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write RT Count Range 0 to Write RT Count</td>
<td>These buckets show the distribution of the number of writes to the FE directors over the specified time range.</td>
</tr>
<tr>
<td>Range Over 64</td>
<td></td>
</tr>
<tr>
<td>Total Read Count</td>
<td>The total number of reads to the FE directors.</td>
</tr>
<tr>
<td>Total Write Count</td>
<td>The total number of writes to the FE directors.</td>
</tr>
<tr>
<td>Read RT 0 to 1 to Read RT Over 64</td>
<td>These buckets show the distribution of the total average read response time.</td>
</tr>
<tr>
<td>Write RT 0 to 1 to Write RT Over 64</td>
<td>These buckets show the distribution of the total average write response time.</td>
</tr>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE director is processing.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing.</td>
</tr>
<tr>
<td>Queue Depth Utilization</td>
<td>A weighted sum of the utilizations according to the number of IOs in each bucket. Queue depth range metrics are used in the calculation.</td>
</tr>
<tr>
<td>Calculation: $Sx=1..9 \left( \frac{\text{Avg Queue Depth Range } X - 1}{\text{Avg Queue Depth Range } X} \right) \times \left( \frac{\text{Queue Depth Count Range } X}{\text{Queue Depth Count Total}} \right) \times 100$</td>
<td></td>
</tr>
<tr>
<td>CCWS Per IO</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>ORS ASync IOs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS ASync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS Sync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ZHPF reads</td>
<td></td>
</tr>
<tr>
<td>ZHPF Reads MBs</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes MBs</td>
<td></td>
</tr>
</tbody>
</table>

**FE Emulation metrics**

The following table lists all metrics that are available for FE emulations.
Table 34 FE emulation metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

FE Port metrics

The following table lists all metrics that are available for FE ports.

Table 35 FE port metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The average number of host reads performed per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of host writes performed per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of IOs the port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The throughput in MBs read per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The throughput in MBs written per second.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of MBs the port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>Max Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the port is busy.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it takes to serve one read IO.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it takes to serve one write IO.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>iSCSI Checksum Error Count</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

FE Port - FE metrics

The following table lists all metrics that are available for FE ports (FE).
Table 36 FE port (FE) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

FE Port - SG metrics

The following table lists all metrics that are available for FE ports (SG).

Table 37 FE port (SG) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

FICON Emulation metrics

The following table lists all metrics that are available for FICON emulations.

Table 38 FICON emulation metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON channel is busy.</td>
</tr>
</tbody>
</table>

FICON Emulation Threads metrics

The following table lists all metrics that are available for FICON emulation threads.

Table 39 FICON emulation threads metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON emulation threads were busy.</td>
</tr>
</tbody>
</table>
Table 39 FICON emulation threads metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Idle</td>
<td>The percent of time the FICON emulation threads were idle.</td>
</tr>
</tbody>
</table>

FICON Port Threads metrics

The following table lists all metrics that are available for FICON emulations.

Table 40 FICON port threads metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON port was busy.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the FICON port was idle.</td>
</tr>
</tbody>
</table>

Host metrics

The following table lists all metrics that are available for hosts.

Table 41 Host metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the host.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the host.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the host.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this host.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this host.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this host.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>Cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>Cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>
Host IO Limit by FE metrics

The following table lists all metrics that are available for host IO limits (by FE).

**Table 42 Host IO limit (by FE) metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

Host IO Limit by SG metrics

The following table lists all metrics that are available for host IO limits (by SG).

**Table 43 Host IO limit (by SG) metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

IM Director metrics

The following table lists all metrics that are available for IM directors.

**Table 44 IM director metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Memory Page Usage</td>
<td></td>
</tr>
<tr>
<td>Memory Page Fall thru Time</td>
<td></td>
</tr>
</tbody>
</table>

IM Emulation metrics

The following table lists all metrics that are available for IM emulations.
Table 45 IM emulations metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

Initiator metrics

The following table lists all metrics that are available for initiators.

Table 46 Initiator metrics

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the initiator.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the initiator.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this initiator.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this initiator.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this initiator.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

Initiators by Port metrics

The following table lists all metrics that are available for initiators (by port).

Table 47 Initiators (by port) metrics

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the initiator (by port).</td>
</tr>
</tbody>
</table>
Table 47 Initiators (by port) metrics (continued)

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the initiator (by port).</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this initiator (by port).</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this initiator (by port).</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this initiator (by port).</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

**IP Interface metrics**

The following table lists all metrics that are available for IP interfaces.

Table 48 IP interface metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets/sec</td>
<td></td>
</tr>
<tr>
<td>MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Duplicate Acks Received/sec</td>
<td></td>
</tr>
<tr>
<td>TCP Retransmits/sec</td>
<td></td>
</tr>
</tbody>
</table>

**iSCSI Target metrics**

The following table lists all metrics that are available for iSCSI targets.

Table 49 iSCSI target metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets/sec</td>
<td></td>
</tr>
<tr>
<td>MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Duplicate Acks Received/sec</td>
<td></td>
</tr>
</tbody>
</table>
Table 49 iSCSI target metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP Retransmits/sec</td>
<td></td>
</tr>
</tbody>
</table>

Masking View metrics

The following table lists all metrics that are available for masking views.

Table 50 Masking view metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the masking group.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>Number of MBs per second being processed for the specific masking group.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it takes to serve one read IO.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it takes to serve one write IO.</td>
</tr>
<tr>
<td>Capacity (GB)</td>
<td>The total capacity of the masking group in GBs.</td>
</tr>
</tbody>
</table>

Metas metrics

The following table lists all metrics that are available for metas.

Table 51 Metas metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
</tbody>
</table>
| Write Miss RT (ms)     | The average time a write miss operation was performed by the volume. A miss occurs when
### Table 51: Metas metrics (continued)

<table>
<thead>
<tr>
<th><strong>Metric</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
</tbody>
</table>
### Table 51 Metas metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>data is not there or the operation has to wait while data is destaged from cache to disks.</td>
<td></td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the meta.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the meta.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>XtremSW Cache Read Hits/sec</td>
<td>The cumulative number of reads that were hits by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Write Hits/sec</td>
<td>The cumulative number of writes that were hits by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Reads/sec</td>
<td>The average time it took XtremSW Cache to serve one read.</td>
</tr>
<tr>
<td>XtremSW Cache Writes/sec</td>
<td>The average time it took XtremSW Cache to serve one write.</td>
</tr>
<tr>
<td>XtremSW Cache IOs/sec</td>
<td>The average time it took XtremSW Cache to serve one IO.</td>
</tr>
<tr>
<td>XtremSW Cache Skipped IOs/sec</td>
<td>The number of IOs that were skipped by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Hits/sec</td>
<td>The number of XtremSW Cache Dedup hits per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Reads/sec</td>
<td>The number of XtremSW Cache Dedup reads per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Writes/sec</td>
<td>The number of XtremSW Cache Dedup writes per second.</td>
</tr>
<tr>
<td>% XtremSW Cache Reads</td>
<td>The percent of XtremSW Cache IO that were reads.</td>
</tr>
<tr>
<td>% XtremSW Cache Writes</td>
<td>The percent of XtremSW Cache IO that were writes.</td>
</tr>
<tr>
<td>% XtremSW Cache Read Hits</td>
<td>The percent of XtremSW Cache IO that were read hits.</td>
</tr>
<tr>
<td>XtremSW Cache MBs Read/sec</td>
<td>Cumulative number of host MBs read by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache MBs Written/sec</td>
<td>Cumulative number of host MBs written by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache MBs/sec</td>
<td>Cumulative number of host MBs read and written by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Read RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one read.</td>
</tr>
<tr>
<td>XtremSW Cache Write RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one write.</td>
</tr>
<tr>
<td>XtremSW Cache RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one IO.</td>
</tr>
<tr>
<td>XtremSW Cache Avg Read Size (KB)</td>
<td>The average size of a read served by XtremSW Cache.</td>
</tr>
</tbody>
</table>
Table 51 Metas metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XtremSW Cache Avg Write Size (KB)</td>
<td>The average size of a write served by XtremSW Cache.</td>
</tr>
<tr>
<td>XtremSW Cache Avg IO Size (KB)</td>
<td>The average size of an IO served by XtremSW Cache.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

Other - Pool Bound Volume metrics

The following table lists all metrics that are available for pool-bound volumes.

Table 52 Pool-bound volumes metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value:100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
</tbody>
</table>
### Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the</td>
</tr>
</tbody>
</table>
### Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th><strong>Metric</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the pool in GBs.</td>
</tr>
</tbody>
</table>
### Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

### Pool by Storage Group metrics

The following table lists all metrics that are available for pools by storage group.

### Table 53 Pool by storage group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of data transfers between cache and the pool by storage group.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The allocated capacity for the pool by storage group in GBs.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + destaged writes) / capacity</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>A data transfer of a read between the cache and the director.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
</tbody>
</table>
Table 53 Pool by storage group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Pretetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

**Port Group metrics**

The following table lists all metrics that are available for port groups.

Table 54 Port group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The average number of host reads performed per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of host writes performed per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs read each second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the port group is busy.</td>
</tr>
</tbody>
</table>

**RDF Director metrics**

The following table lists all metrics that are available for RDF directors.

Table 55 RDF director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The average IO count per second for the director.</td>
</tr>
<tr>
<td>Avg IO Service Time (ms)</td>
<td>The average time the director takes to serve IO.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>The write requests per second.</td>
</tr>
<tr>
<td>MBs Sent and Received/sec</td>
<td>The total read and write MBs on the RDF director per second.</td>
</tr>
<tr>
<td>MBs Sent/sec</td>
<td>The size of the host data transfer in MBs for the director.</td>
</tr>
<tr>
<td>MBs Received/sec</td>
<td>The size of the data received in MBs for the director.</td>
</tr>
<tr>
<td>Avg IO Size Received (KB)</td>
<td>Calculated value: (MBs received per sec / reads per sec)</td>
</tr>
<tr>
<td>Avg IO Size Sent (KB)</td>
<td>Calculated value: (MBs sent per sec / writes per sec)</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>The time to satisfy the calls by this director.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent via RDF to a remote system.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>Calculated value: (syscall time / syscall count)</td>
</tr>
<tr>
<td>Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Tracks Received/sec</td>
<td>The number of tracks received by this director per second.</td>
</tr>
<tr>
<td>Tracks Sent/sec</td>
<td>The number of tracks sent by this director per second.</td>
</tr>
<tr>
<td>Copy IOs/sec</td>
<td>The number of copy IOs per second via this RDF director. Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1-&gt;R2 copy of tracks (due to invalids) is a “copy.”</td>
</tr>
</tbody>
</table>
### RDF director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy MBs/sec</td>
<td>The throughput of copy MBs per second via this RDF director.</td>
</tr>
<tr>
<td>Sync Write Reqs/sec</td>
<td>The number of sync write requests managed by this RDF director per second.</td>
</tr>
<tr>
<td>Sync MBs Sent/sec</td>
<td>The number of sync MBs sent per second via this RDF director.</td>
</tr>
<tr>
<td>Async Write Reqs/sec</td>
<td>The number of async write requests managed by this RDF director per second.</td>
</tr>
<tr>
<td>Async MBs Sent/sec</td>
<td>The number of async MBs sent per second via this RDF director.</td>
</tr>
<tr>
<td>% Compressed MBs Sent and Received/sec</td>
<td>Calculated value: ((Compressed MBs Sent and Received/sec / MBs Sent and Received/sec) * 100)</td>
</tr>
<tr>
<td>% Compressed MBs Received/sec</td>
<td>Calculated value: ((Compressed MBs Received/sec / MBs Received/sec) * 100)</td>
</tr>
<tr>
<td>% Compressed MBs Sent/sec</td>
<td>Calculated value: ((Compressed MBs Sent/sec / MBs Sent/sec) * 100)</td>
</tr>
<tr>
<td>Compressed MBs Sent and Received/sec</td>
<td>The number of compressed MBs sent and received by this RDF director.</td>
</tr>
<tr>
<td>Compressed MBs Received/sec</td>
<td>The number of compressed MBs/sec received by this RDF director.</td>
</tr>
<tr>
<td>Compressed MBs Sent/sec</td>
<td>The number of compressed MBs/sec sent by this RDF director.</td>
</tr>
<tr>
<td>Number of Compressed Links</td>
<td>The number of compressed links used by this RDF director.</td>
</tr>
<tr>
<td>Number of Links</td>
<td>The number of links used by this RDF director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>The average number of requests performed by the director per second.</td>
</tr>
</tbody>
</table>

### RDF Emulation metrics

The following table lists all metrics that are available for RDF emulations.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
</tbody>
</table>
RDF Port metrics

The following table lists all metrics that are available for RDF ports.

**Table 57 RDF port metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed by the port per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed by the port per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the port.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>Max Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

RDF/A Group metrics

The following table lists all metrics that are available for RDF/A groups.

**Table 58 RDF/A group metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Cycle Time</td>
<td>The mean time (in seconds) of the last 16 cycles. (Calculated as true averages- e.g. if only 8 cycles have occurred, the average represents those 8 cycles only.)</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Cycle Size</td>
<td>The average size of all the cycles in RDFA sessions.</td>
</tr>
<tr>
<td>Avg IO Service Time (ms)</td>
<td>The average time the director takes to serve IO.</td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Duration of Last Cycle</td>
<td>The cycle time (in seconds) of the most recently completed cycle. It should be noted</td>
</tr>
</tbody>
</table>
Table 58 RDF/A group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>that in a regular case the cycles switch every ~30 sec, however, in most cases the collection interval is in minutes, which means some cycle times will be skipped. This an important counter to look at to figure out if SRDF/A is working as expected.</td>
</tr>
<tr>
<td>Total HA Writes/sec</td>
<td>The total host adapter writes, measured in write commands to SRDF/A volumes only.</td>
</tr>
<tr>
<td>Total HA Repeat Writes/sec</td>
<td>The total number of writes to a slot already in the active cycle. Total host adapter repeat writes, measured in write commands to SRDF/A volumes only. This counter helps estimate the cache locality of reference, i.e., how much cache is saved by the re-writes. This does not give any indication to the bandwidth locality of reference.</td>
</tr>
<tr>
<td>RDF R1 to R2 IOs/sec</td>
<td>The number of IOs/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R1 to R2 MBs/sec</td>
<td>The MB/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R2 to R1 IOs/sec</td>
<td>The number of IOs/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R2 to R1 MBs/sec</td>
<td>The MB/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>System WP Limit</td>
<td>The maximum number of write-pending slots for the entire storage system.</td>
</tr>
<tr>
<td>System WP Count</td>
<td>The number of system cache slots that are write pending.</td>
</tr>
<tr>
<td>Local WP Count</td>
<td>The number of write pending slots waiting to be de-staged to disk. On the R1 - should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>RDF/A WP Count</td>
<td>The number of RDF/A writes pending.</td>
</tr>
<tr>
<td>DSE Used Tracks</td>
<td>The active cycle spilled count plus the inactive cycle spilled count.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of tracks read from the R2 (host reads + copy).</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The total amount of data read from the R2 in MBs+G5.</td>
</tr>
<tr>
<td>Time Since Last Switch</td>
<td>The time (in seconds) since the last switch from active to inactive or vice versa. Since in a regular case the cycles switch every ~30 sec and the samples are taken every few Second, the default collection interval is in minutes, which means some cycle times will be skipped. This an important counter to look at to figure out if SRDF/A is working as expected.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>minutes, this counter may not show very significant data, however, when cycles elongate beyond the sample time, this counter can help indicate an estimate of the R1 to R1 lag time.</td>
</tr>
<tr>
<td>Active Cycle Size</td>
<td>The count of cache slots that measures the amount of data captured (on the R1 side) or received (on the R2 side).</td>
</tr>
<tr>
<td>Inactive Cycle Size</td>
<td>The count of cache slots that measures the amount of data transmitted (on the R1 side) or applied (on the R2 side).</td>
</tr>
<tr>
<td>RDF/A Session Indicator</td>
<td>Indicates if group is RDFA (0/1).</td>
</tr>
<tr>
<td>RDF/A Active Indicator</td>
<td>Indicates if RDF/A group is active (0/1).</td>
</tr>
<tr>
<td>Cycle Number</td>
<td>The active cycle number identifier for the given SRDF/A session. In a regular case, the cycles switch every ~30 seconds, however, in most cases the collection interval is in minutes. Calculating the difference in cycle numbers between collection intervals relative to the minimum cycle time will show how many cycles occurred over the last interval.</td>
</tr>
<tr>
<td>R1 to R2 Lag Time</td>
<td>The time that R2 is behind R1 (RPO). This is calculated as the last cycle time plus the time since last switch. In a regular case, the cycles switch every ~30 sec and the samples are taken every few minutes, therefore this counter may not show very significant data, however, when cycles elongate beyond the sample time, this counter can help indicate an estimate of the RPO.</td>
</tr>
<tr>
<td>Num Devs in Session</td>
<td>The number of storage volumes defined in this session.</td>
</tr>
<tr>
<td>R2 Last Restore Time</td>
<td>The time, in seconds, that the restore of the last active cycle took to complete. The restore is an operation done by the DA and RA to mark the tracks in the apply cycle as Write Pending to the local drives. This operation is usually a very quick cache operation, unless one of the volumes reaches its WP limit. The importance of this counter is that is shows one of the common reasons for an increase in the cycle time.</td>
</tr>
<tr>
<td>DSE Threshold</td>
<td>The percent of write pendings before DSE activates.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write requests to the RDF director per second.</td>
</tr>
</tbody>
</table>
Table 58 RDF/A group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Number</td>
<td>The number of the SRDF/A session.</td>
</tr>
<tr>
<td>Uncommitted Tracks</td>
<td>The number of tracks for all the SRDF/A volumes in the session that have not been committed to the R2 volume.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of MBs written per second for the SRDF/A session.</td>
</tr>
<tr>
<td>Read Hits/sec</td>
<td>The total number of read operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Spillover Packed Slots</td>
<td></td>
</tr>
<tr>
<td>Number of Links</td>
<td>The number of links used by this RDF/A group.</td>
</tr>
<tr>
<td>Number of Compressed Links</td>
<td>The number of compressed links used by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Received/sec</td>
<td>The number of compressed MBs/sec received by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Sent/sec</td>
<td>The number of compressed MBs/sec sent by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Sent and Received/sec</td>
<td>The number of compressed MBs sent and received by this RDF/A group.</td>
</tr>
<tr>
<td>% Compressed MBs Received</td>
<td>Calculated value: ((\text{Compressed MBs Received/sec / MBs Received/sec}) \times 100)</td>
</tr>
<tr>
<td>% Compressed MBs Sent</td>
<td>Calculated value: ((\text{Compressed MBs Sent/sec / MBs Sent/sec}) \times 100)</td>
</tr>
<tr>
<td>% Compressed MBs Sent and Received</td>
<td>Calculated value: ((\text{Compressed MBs Sent and Received/sec / MBs Sent and Received/sec}) \times 100)</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Total Tracks Spilled Back</td>
<td></td>
</tr>
</tbody>
</table>
Table 58 RDF/A group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tracks Spilled Over</td>
<td></td>
</tr>
<tr>
<td>Total Tracks Spilled Over Used</td>
<td></td>
</tr>
</tbody>
</table>

RDF/S Group metrics

The following table lists all metrics that are available for RDF/S groups.

Table 59 RDF/S group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the RDF/S Group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
</tbody>
</table>
Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read IO for this group.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write IO for this group.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write miss IO for this group.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>Number of IO operations performed each second that were sequential.</td>
</tr>
</tbody>
</table>
Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seq Reads/sec</td>
<td>Number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>Number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>Number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>Number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>Number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>Number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
</tbody>
</table>
### Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
</tbody>
</table>
### Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the device group.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
</tbody>
</table>
Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Spillover Packed Slots</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

SAVE Volume metrics

The following table lists all metrics that are available for SAVE volumes.

Table 60 SAVE volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
</tbody>
</table>
Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100*(seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
</tbody>
</table>
### Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated volume capacity in GBs.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume in GBs.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
</tbody>
</table>
### Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

### Snap Pool metrics

The following table lists all metrics that are available for snap pools.

#### Table 61 Snap pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
</tbody>
</table>

### Spare Disk metrics

The following table lists all metrics that are available for spare disks.
## Table 62 Spare disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the Symmetrix disk each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of host read and write requests for the disk.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the disk per second.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Seeks/sec</td>
<td>The number of times each second that the disk head moved to find data.</td>
</tr>
<tr>
<td>Seek Distance/sec</td>
<td>The number of hypervolumes that the disk head crossed (during all seeks) each second.</td>
</tr>
<tr>
<td>Avg Hypers per Seek</td>
<td>The average number of hypervolumes that the disk head crossed during one seek.</td>
</tr>
<tr>
<td>Verify Commands/sec</td>
<td>The number of commands that verify the integrity of the data on the disk.</td>
</tr>
</tbody>
</table>
Table 62 Spare disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skip Mask Commands/sec</td>
<td>The skip mask support offers an emulation of the ability to efficiently transfer “nearly sequential” streams of data. It allows a sequential read or write to execute but “skip over” certain unwanted or unchanged portions of the data stream, thereby transferring only those portions of the sequential stream that have changed and need to be updated. The skip mask mechanism increases throughput by saving bandwidth; both the bandwidth of processing multiple commands and the bandwidth of transferring unnecessary data.</td>
</tr>
<tr>
<td>XOR Write Commands/sec</td>
<td>The number of exclusive OR (XOR) write commands performed each second by the disk. XOR commands are used to establish parity protection in RAID-S and RAID 5 configurations.</td>
</tr>
<tr>
<td>XOR Read Commands/sec</td>
<td>The number of exclusive OR (XOR) write commands performed each second by the disk. XOR commands are used to establish parity protection in RAID-S and RAID 5 configurations.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk that is used.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
</tbody>
</table>

SRP metrics

The following table lists all metrics that are available for SRPs.

Table 63 SRP metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the SRP.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>Host write operations performed each second by the SRP.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs read each second.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the SRP.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the SRP.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this SRP.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this SRP.</td>
</tr>
<tr>
<td>Overall Efficiency Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td>% Snapshot Saved</td>
<td>Percentage savings of the sum of all TDEV Snapshot sizes (at the time of Snapshot creation) and the TDEV Snapshot Allocated Storage.</td>
</tr>
<tr>
<td>% Virtual Provisioning Saved</td>
<td>Percentage savings of the TDEV configured storage presented to the hosts and the TDEV Allocated Storage.</td>
</tr>
<tr>
<td>Virtual Provisioning Compression Ratio</td>
<td>Ratio of the TDEV Logical Backend Storage (calculated based on the 128K track size) and the TDEV Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Virtual Provisioning Efficiency Ratio</td>
<td>Ratio of the TDEV configured storage and the TDEV Logical Backend Storage (calculated based on TDEV allocated tracks without shared unowned).</td>
</tr>
<tr>
<td>Virtual Provisioning Shared Ratio</td>
<td>Ratio of the TDEV allocated storage and the TDEV Logical Backend Storage. Backend Storage is the sum of TDEV allocated tracks without counting the TDEV shared unowned tracks.</td>
</tr>
<tr>
<td>Snapshot Compression Ratio</td>
<td>Ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Snapshot Efficiency Ratio</td>
<td>Ratio of the sum of all snapshot sizes and the RDP Logical Backend Storage.</td>
</tr>
<tr>
<td>Snapshot Shared Ratio</td>
<td>Ratio of the Snapshot Allocated Storage and the RDP Logical Backend Storage. Sum of all modified tracks on all snapshots / Sum of the RDP size for all snapshot.</td>
</tr>
<tr>
<td>Overall Compression Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Total SRP Capacity GB</td>
<td>The total amount of capacity available in all SRPs in GB.</td>
</tr>
</tbody>
</table>
Table 63 SRP metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used SRP Capacity GB</td>
<td>The amount of used capacity in all SRPs in GB.</td>
</tr>
</tbody>
</table>

**Storage Group metrics**

The following table lists all metrics that are available for storage groups.

Table 64 Storage group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
</tbody>
</table>
### Table 64 Storage group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the storage to serve one read IO for this group.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the storage to serve one write IO for this group.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the storage to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the storage to serve one write miss IO for this group.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>The percent of IO operations that were sequential.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: (100 \times \frac{\text{seq reads per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: (100 \times \frac{\text{seq writes per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: (100 \times \frac{\text{random read hits per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: (100 \times \frac{\text{random write misses per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: (100 \times \frac{\text{random read misses per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: (100 \times \frac{\text{random write hits per sec}}{\text{total IOs per sec}})</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: ((\text{MBs read per sec} + \text{MBs written per sec}))</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>Total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>Read RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Read RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Skew</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>Read RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Read RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Write RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The KBs of back-end IO that were partial sector writes.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated storage group capacity.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the storage group (GBs).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The total number of tracks for the storage group.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write paced delay</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Sync Write Reqs/sec</td>
<td>The number of sync write requests managed by this storage group per second.</td>
</tr>
</tbody>
</table>
### Storage Group by Pool metrics

The following table lists all metrics that are available for storage groups (by pool).

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td></td>
</tr>
</tbody>
</table>

---

### Note

Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.
### Table 65 Storage group (by pool) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Pretetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td></td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the storage group.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

### Storage Group by Tier metrics

The following table lists all metrics that are available for storage groups (by tier).

### Table 66 Storage group (by tier) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the storage group (by tier).</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity. With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td></td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
</tbody>
</table>
### Table 66 Storage group (by tier) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destage Write MBs/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks.</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

### Thin Pool metrics

The following table lists all metrics that are available for thin pools.

### Table 67 Thin pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written each second by the disk directors.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the thin pool.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
</tbody>
</table>
### Table 67 Thin pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>BE Read RT (ms)</td>
<td>A calculated value of the response time for all back-end read requests.</td>
</tr>
<tr>
<td>BE Write RT (ms)</td>
<td>A calculated value of the response time for all back-end write requests.</td>
</tr>
<tr>
<td>BE Response Time (ms)</td>
<td>A calculated value of the response time for all back-end read and write requests.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end requests that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end requests that were write requests.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Redirect On Write</td>
<td></td>
</tr>
<tr>
<td>Copy on Write</td>
<td></td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Written For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Read For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 67 Thin pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Written For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the thin pool (GBs).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The number of allocated tracks in the thin pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the thin pool.</td>
</tr>
<tr>
<td>Compression Scan Reads</td>
<td></td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
</tbody>
</table>

### Thin Volume metrics

The following table lists all metrics that are available for thin volumes.

### Table 68 Thin volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume that were immediately satisfied by cache.</td>
</tr>
</tbody>
</table>
Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the</td>
</tr>
<tr>
<td></td>
<td>volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the</td>
</tr>
<tr>
<td></td>
<td>volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second</td>
</tr>
<tr>
<td></td>
<td>by the volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the</td>
</tr>
<tr>
<td></td>
<td>volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the</td>
</tr>
<tr>
<td></td>
<td>volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>Number of read/write requests each second performed by the disk directors</td>
</tr>
<tr>
<td></td>
<td>to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to</td>
</tr>
<tr>
<td></td>
<td>the cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors</td>
</tr>
<tr>
<td></td>
<td>to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A</td>
</tr>
<tr>
<td></td>
<td>miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A</td>
</tr>
<tr>
<td></td>
<td>miss occurs when the write operation has to wait while data is destaged</td>
</tr>
<tr>
<td></td>
<td>from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq ios per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100* (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
</tbody>
</table>
Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Pretetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td></td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td></td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the thin volume (GB).</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the thin volume (GB).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
</tbody>
</table>
Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to WP slots per second</td>
<td>Number of writes to affect the back end.</td>
</tr>
<tr>
<td>Random Writes to WB Slots in KB per second</td>
<td>The amount of writes to affect the back end (KB).</td>
</tr>
</tbody>
</table>

**Tier by Storage Group metrics**

The following table lists all metrics that are available for tiers (by storage group).

Table 69 Tier (by storage group) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity</td>
</tr>
<tr>
<td></td>
<td>With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
</tbody>
</table>
Table 69 Tier (by storage group) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the storage group.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks.</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

Virtual Pool Tier metrics

The following table lists all metrics that are available for virtual pool tiers.

Table 70 Virtual pool tier metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Capacity (GB)</td>
<td>Allocated capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The total number of tracks for the virtual pool.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE RT (ms)</td>
<td>A calculated value of the response time for all back-end read requests.</td>
</tr>
<tr>
<td>BE Read RT (ms)</td>
<td>A calculated value of the response time for all back-end write requests.</td>
</tr>
<tr>
<td>BE Write RT (ms)</td>
<td>A calculated value of the response time for all back-end write requests.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the thin pool.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Read For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Blocks Written For Copy (KB)</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Written For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 70 Virtual pool tier metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the virtual pool tier.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the virtual pool tier that is used.</td>
</tr>
<tr>
<td>% Write</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total capacity of the virtual pool.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode.</td>
</tr>
</tbody>
</table>

### Volume metrics

The following table lists all metrics that are available for volumes.
Table 71 Volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
</tbody>
</table>
Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
</tbody>
</table>
### Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100*(seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
</tbody>
</table>
Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated volume capacity.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

About exporting and importing performance settings

In large environments, it can be very time consuming to setup and configure multiple instances. Storage systems may have very similar configuration and implementations across the environment. To assist with the implementation process, the following settings can be exported and imported:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

The settings are saved to an XML file. You can select the client-side directory in which the file is saved. When importing a metrics definition file, it replaces any existing metrics definition file. When importing a user template dashboard, any existing templates remain intact; only non-conflicting templates are imported.
Importing Performance settings

Before you begin

For security compliance, a password must be supplied upon exporting and importing a performance settings file. If you pass the settings file to another administrator, ensure that you also provide the password.

To import Performance settings:

You can import the following items:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

For more information about exporting and importing Performance settings, see About exporting and importing performance settings on page 807.

Procedure

1. Click Performance > Import Settings to open the Import Settings dialog box.
2. Select the settings to import: Metrics and Alert Definitions, User Templates, or both.
3. Click Browse to select the settings file to import.
4. Enter the file password (which was set during the export process).
5. Click OK.

Exporting Performance Viewer settings

If you are using the offline Performance Viewer, you can export databases, thresholds, reports, user dashboards, and template dashboards.

To export Performance Viewer settings:

Procedure

1. Click Performance > Export PV Settings
2. Select the settings to export: SYMAPI Database, Settings, or both.
   - If you select SYMAPI Database, specify a file name for the BIN file.
   - If you select Settings, specify a file name for the ZIP file. In addition, select the types of settings you want to export. The following settings are available:
     - Thresholds (default and custom)
     - Reports
     - User Defined Dashboards
     - Templates
3. Click OK.

Unisphere for VMAX attaches a date and time stamp to the name of the file(s) in GMT format, so that exported configuration files have the format StartTime_Filename.zip. They are automatically saved in the following directories:
Exporting Performance settings

Before you begin

For security compliance, a password must be supplied upon exporting and importing a performance settings file. If you pass the settings file to another administrator, ensure that you also provide the password.

You can import the following items:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

For more information about exporting and importing Performance settings, see About exporting and importing performance settings on page 807.

To export Performance settings:

Procedure

1. Click Performance.
2. Under Common Tasks, click Export Settings to open the Export Settings dialog box.
3. Select the settings to export: Metric and Alert Definitions, User Templates, or both.
4. Enter and confirm a file password.
   The settings file cannot be imported to another Unisphere environment without supplying the password set in this step.
5. Click OK.
6. In the Save Settings dialog, click OK.
7. In the Save File dialog box select the location to which you want to save the settings file.
8. Click Save.

Filtering performance data

Unisphere for VMAX includes different ways to filter performance data depending on the situation:

- Filter performance charts and heatmaps by name. This allows you to filter for specific objects by name. For example, the name of a storage group.
- Filter performance charts and heatmaps by ID. This allows you to filter lists according to an ID of a particular object. For example, the ID of a volume.
- Filter performance charts and heatmaps by object. This allows you to filter lists according to an instance of a particular object. For example, a particular storage group or database.
- Filter analyze views by name.
Filtering performance charts and heatmaps

Procedure
1. Click the filter icon \(\vec{\text{ }}\) to open the filter dialog box.
2. Depending on the type of filter, some of the following options are available:
   - Filter by name. To do this, in the **Name** field, type all or part of the object’s name.
   - Filter by instance. To do this, complete the following steps:
     a. From the **Context** menu, select an object type. The **Instances** list updates to show the objects of that type.
     b. Select the object from the **Instances** list. You can filter the **Instances** list by typing all or part of the object's name in the **Instances** field.
   - Filter by ID. To do this, complete the following steps:
     a. From the **Context** menu, select **By ID**.
     b. In the **ID** field, type all or part of the ID.
3. Click **OK**.

Filtering analyze views

Procedure
1. Click the filter icon \(\vec{\text{ }}\) to expand the **Filtered by** field.
2. In the **Filtered by** field, type all or part of the name.
   To clear the filter, click **Reset**.

Changing the time range

Use the options in the **Custom Time Selection** dialog to specify a custom time range for performance reports or to specify a data collection time range for an analyze view.

In the **Analyze** tab, there are the following default data collection time ranges:

**Real Time Analysis**
- The previous 1 hour.

**Root Cause Analysis**
- The previous 4 hours.

**Trending & Planning**
- The previous 7 days.

For the **Real Time Analysis** view, you can load an existing real-time trace file. After a trace file is specified, the time range is displayed to the left of the time selection menu.

For the **Root Cause Analysis** and **Trending & Planning** views, you can customize the time range by specifying a custom time range in the **Custom Time Selection** window.

When specifying a custom Root Cause Analysis time range, you can define a maximum range of 24 hours, specified at five-minute intervals.

When specifying a custom Trending & Planning time range, you can define a minimum range of 24 hours, specified at one-hour intervals.
After a custom time range is specified, the time range is displayed to the left of the time selection menu.

**Procedure**

1. Complete one of the following:

   - **Changing the Real Time Analysis time range:**
     
     From the time selection menu, which by default displays Last Hour, select one of the following options:
     
     - Select Last Hour to view the last hour of data collected.
     - Select Trace and choose a saved trace file from the list. This option is available only if a trace file is available for the selected storage system.

   - **Changing the Root Cause Analysis time range:**
     
     a. From the time selection menu, which by default displays Last 4 Hours, select one of the following options:
     
     - Select Last Hour to view the last hour of data collected.
     - Select Last 2 Hours to view the last two hours of data collected.
     - Select Last 4 Hours to view the last four hours of data collected.
     - Select Last 8 Hours to view the last eight hours of data collected.
     - Select Last 24 Hours to view the last 24 hours of data collected.
     - Select Custom to make a custom time selection. To do this, complete the following steps:
       
       a. In the Custom Time Selection dialog box, specify a start time and end time.
       
       b. Click OK.

   - **Changing the Trending & Planning time range:**
     
     a. From the time selection menu, which by default displays Last 24 Hours, select one of the following options:
     
     - Select Last Hour to view the last hour of data collected.
     - Select Last 2 Hours to view the last two hours of data collected.
     - Select Last 4 Hours to view the last four hours of data collected.
     - Select Last 8 Hours to view the last eight hours of data collected.
     - Select Last 24 Hours to view the last 24 hours of data collected.
     - Select Custom to make a custom time selection. To do this, complete the following steps:
       
       a. In the Custom Time Selection dialog box, specify a start time and end time.
       
       b. Click OK.

**Saving dashboards and charts**

When viewing a dashboard or chart, you can export it to a PDF file or save it as an image file (JPG or PNG file format). When exporting to PDF, you can export the chart or dashboard only, or the dashboard or chart with the data also included in a table.
If multiple dashboards are displayed on different tabs, exporting to a PDF saves each chart or dashboard. Saving a dashboard or chart as an image file saves only the currently displayed dashboard or chart.

**Saving a dashboard or chart to an image file**

**Procedure**

1. Open the dashboard or chart that you want to save.
2. Click **Save As**.
3. Select the image format you want to use. The following choices are available:
   - JPG
   - PNG
4. In the **Save As** window, navigate to the folder to which you want to save the image, and change the file name, if required.
5. Click **Save**.

**Saving a dashboard to PDF**

**Procedure**

1. From the **Monitor** view or the **Plan** view, open the dashboard you want to save.
2. Click **Save As**.
3. Select the information you want to export to PDF. The following choices are available:
   - PDF - Charts
   - PDF - Chart & Data
4. In the **Save Reports Results** window, click **OK**.
5. In the **Save As** window, navigate to the folder to which you want to save the image, and change the file name, if required.
6. Click **Save**.

**Opening a dashboard image in a new browser tab**

**Note**

This functionality is available only when using Firefox or Chrome web browsers.

**Procedure**

1. Using Firefox or Chrome, open the dashboard or chart that you want to save.
2. Click **Save As > To Clipboard**.
3. A JPG image of the current dashboard opens in a new browser tab.
   From there, you can copy it to the clipboard and paste it to another application, for example, into a presentation.
CHAPTER 8

Databases

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- Viewing databases .................................................................................................. 814
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Understanding Database Storage Analyzer

Database Storage Analyzer (DSA) provides a database troubleshooting solution for Oracle and SQL server databases on storage systems running Enginuity 5773, 5876, or HYPERMAX OS 5977 or higher.

DSA supports database to storage correlation by providing a shared view on how performance issues correlate to database level activity and storage level activity. This view is viewable by a database analyst (DBA) and a storage administrator (SA). The view presents I/O metrics such as IOPS, throughput and response time from both the database and the storage system which immediately highlights any gap between the database I/O performance and the storage I/O performance.

In addition, DSA supports hinting capabilities for Oracle databases on storage systems running HYPERMAX OS 5977 or higher that allows users to prioritize mission-critical database processes in order to achieve improved response time. To perform hinting operations, you must be a DSA Admin with hinting permission.

The Database Storage Analyzer help system contains more information.

Viewing databases

Before you begin

This feature requires Enginuity 5773, 5876, or HYPERMAX OS 5977 or higher.

This procedure explains how to view database instance information provided by Database Storage Analyzer. StorageAdmin and Database Administrators can use this view to troubleshoot database and storage issues.

Only databases monitored by DSA will appear in this view. For instructions on adding monitored databases, refer to the DSA online help.

Databases associated with redo logs will have two entries in this view, one for the data file, and one for the redo log (indicated with (REDO) after the ID).

To view databases:

Procedure

1. Select the storage system.
2. Select Databases > Databases to open the Database list view.

The following properties display:

- **DB ID**—Database ID. (REDO) indicates that the entry is for a redo log.
- **Environment Name**—Database name.
- **DB Host**— Name of the host on which the database is installed.
- **Type**— Type of database application.
- **Volumes**—Total number of volumes in the storage group used by the database.
- **Database Capacity (GB)**—Size of the database.
- **Storage Capacity (GB)**— Total capacity of the database volumes.

The following controls are available:
Viewing database details

Before you begin

This feature requires Enginuity 5773, 5876, or HYPERMAX OS 5977 or higher.

To view databases:

Procedure

1. Select the storage system.
2. Select Databases > Databases.
3. Select the database and click View Details to open its Details view.

   The following properties display:
   - Environment Name—Database name.
   - DB Host—Name of the host on which the database is installed.
   - Type—Type of database application.
   - Hints—Number of hints associated with the database.
   - Number of Volumes—Total number of volumes in the storage group used by the database.
   - Storage Capacity—Total capacity of the database volumes.
   - Database Capacity—Size of the database.

   The following control is available:
   - Database Storage Analyzer—Launching Database Storage Analyzer on page 815.

Launching Database Storage Analyzer

Before you begin

This feature requires Enginuity 5773, 5876, or HYPERMAX OS 5977 or higher.

To launch Database Storage Analyzer:

Procedure

1. Select the storage system.
2. Select Databases > Databases.
3. Click Database Storage Analyzer.
CHAPTER 9
System Management

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- Viewing Storage System details.......................................................... 821
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Monitoring storage systems

The system dashboard provides you with a single place from which to monitor a storage system, including capacity, hardware, and alert information.

Before you begin

- To access this dashboard, you must be a Monitor, StorageAdmin or higher.
- The information displayed in this dashboard is static, in that it reflects the system's status at the moment you opened the dashboard. To refresh the data, click refresh in the status bar.

Procedure

1. To access the System Dashboard:
   1. Select the storage system.
   2. Select System > System Dashboard.

The System Dashboard includes the following panels:

Summary

- Array nice name, or if not defined, the array serial number. To set a custom name for the array, select the current name, type the new name, and click OK. Array names must be unique from other array name and cannot exceed 32 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Array names are case-insensitive.
- Alert summary icon displaying the alert status and count. Alert status is indicated by icon color:
  - One or more fatal alerts
  - One or more critical alerts, with none higher
  - One or more warning alerts, with none higher
  - One or more informational alerts, with none higher
  - No alerts

To view details on the system's alerts, click the icon to open the system's alert list view.

- ID—Storage system serial number.
- Model—Storage system model number.
- HYPERMAX OS/Enginuity—Storage system operating environment. When below the minimum suggested version, this value will be in red.
- Connection—Whether the storage system is local or remote.
- Cache Size—Amount of cache configured on the storage system.
- D@RE Enabled — Only displays when Data at Rest Encryption is enabled on the storage system.
• **File Dashboard**—Opens the File System dashboard. This option is only available for storage systems running HYPERMAX OS 5977 or higher with file systems installed.

• **Symmetrix Details**—Opens the Symmetrix Details view, from which you can view additional details on the storage system.

• **View Reservations**—Opens the Reservations list view, from which you can view and manage the system's reservations. This option is only available for storage systems running HYPERMAX OS 5977 Q32016 or higher.

• **Emulation Management**—Opens the Emulation Management wizard, from which you can add or remove Director Emulation.

**Hardware**

Displays the alert status and count for the system's **Front End**, **RDF**, and **Back End** directors, **Available Ports** (HYPERMAX OS 5977 or higher), and **Cache Partitions** (Enginuity 5773 or 5876). Alert status is indicated by icon color:

- ![Green Icon](image)
  No alerts and status is normal.

- ![Yellow Icon](image)
  One or more warning alerts, with none higher.

- ![Red Icon](image)
  One or more critical alerts, with none higher.

There are no directors of this particular type on the system.

To view additional information on a particular object, click its icon to open the corresponding list view.

If it appears that a director is too busy, click **Available Ports** to open the **Available Ports** list view, from which you can associate additional ports to the director. For more information, refer to Viewing available ports on page 843.

**Health and Maintenance**

• **Health Check**—Displays the status of the last health check run on the storage system:

- ![Green Icon](image)
  Not run

- ![Blue Icon](image)
  Running

- ![Green Icon](image)
  OK

- ![Red Icon](image)
  Requires attention

For more information, click the icon to open the **Health and Maintenance** page, from which you can view details on the last health check.
• **Spare Drive Replacement**—(displayed to Administrators or Storage Admins). Displays the state of the spare drive replacement feature for the storage system:

- Enabled
- Disabled

• **Symmetrix Hardware**—Displays the overall state of the Symmetrix hardware:

- **OK**
- **Requires attention**

**Capacity**

Graphic representation of the storage system’s capacity. The information displayed depends on the storage operating environment:

**HYPERMAX OS 5977 or higher:**

- **Virtual**—Displays the sum of free (blue) over total for all thin pools on the storage system.
- **File Storage**—If NAS file systems are available, this chart displays the NAS file system objects free over the total capacity.

**Enginuity 5773 or 5876:**

- **Physical**—Displays the sum of free (blue) over total for all the disks on the storage system.
- **Virtual**—Displays the sum of free (blue) over total for all thin pools on the storage system.

**Other Hardware**

Displays alert status and count for other types of directors, if they are present on the system. Possible types include, External, IM, and EDS. Alert status is indicated by icon color:

- **No alerts and status is normal.**
- **One or more warning alerts, with none higher.**
- **One or more critical alerts, with none higher.**
Viewing Storage System details

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click Symmetrix Details to open the Symmetrix Details view.

The following properties display:

- **Array Display Name** — Custom nice name assigned to storage system, if any. To assign a name, or change an existing name, click Add Name to open the Set Array Display Name dialog box. Array names must be unique from other array names and cannot exceed 32 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Array names are case-insensitive.
- **Product Model** — The product model.
- **Microcode Version (Number)** — The microcode version.
- **Microcode Date/Patch Date** — The microcode date or patch date.
- **Capacity** — Capacity of the storage system.
- **Used Capacity** — Not applicable to storage systems running HYPERMAX OS 5977.
- **Free capacity** — Not applicable to storage systems running HYPERMAX OS 5977.
- **Actual Capacity** — Not applicable to storage systems running HYPERMAX OS 5977.
- **Cache Size (Mirrored)** — Cache size.
- **Number of Front End Directors** — Number of Front End Directors.
- **Number of Back End Directors** — Number of Back End Directors.
- **Number of RDF Directors** — Number of RDF Directors.
- **Number of Configured (Symm) Devices** — Number of configured devices.
- **Number of Visible (Host) Devices** — Number of visible devices.
- **Number of Configured Actual Disks** — Number of configured actual disks.
- **Number of Configured Spare Disks** — Number of configured spare disks.
- **Number of Unconfigured Disks** — Number of unconfigured disks.
- **Max Number of Hypers per Disk** — Maximum number of hypers per disk.
- **Device Masking (VCM) Config State** — Device Masking VCM configuration state.
- **VCMDB Access Restricted State** — VCMDB Access Restricted State.
- **Device Masking (ACLX) Config State** — Device Masking ACLX configuration state.
- **ACLX Volume LUN Address** — ACLX Volume LUN Address.
- **Access Control Configuration State** — Access Control Configuration state.
- **Configuration Change State** — Configuration Change state.
- **Disk Group Assignments** — Disk Group Assignments.
- **Parity RAID Configuration** — Parity RAID configuration.
- **RAID Configuration** — RAID configuration.
- **PAV Mode** — PAV Mode.
- **PAV Alias Limit** — PAV Alias Limit.
- **SDDF Configuration State** — SDDF Configuration state.
- **WORM Configuration Level** — WORM configuration level.
- **WORM Characteristics** — WORM characteristics.
- **Switched RDF Configuration State** — Switched RDF configuration state.
- **Concurrent RDF Configuration State** — Concurrent RDF configuration state.
- **Dynamic RDF configuration State** — Dynamic RDF configuration state.
- **Concurrent Dynamic RDF State** — Concurrent Dynamic RDF state.
- **RDF Data Mobility Configuration State** — RDF Data Mobility Configuration State.
- **SRDF/A Maximum Host Throttle (Secs)** — SRDF/A Maximum Host Throttle (seconds).
- **SRDF/A Maximum Cache Usage (Percent)** — SRDF/A Maximum Cache Usage (Percent).
- **Multi LRU Device Assignment** — Multi LRU Device Assignment.
- **# of Available Cache Slots** — # of Available Cache Slots.
- **Max # of DA Write Pending Slots** — Max # of DA Write Pending Slots.
- **Max # of System Write Pending Slots** — Max # of System Write Pending slots.
- **Max # of Device Write Pending Slots** — Max # of Device Write Pending slots.
- **Max # of Replication Slots** — not applicable to storage systems running HYPERMAX OS 5977.
- **Symmetrix Last IPL Time (Cold)** — Symmetrix Last IPL Time (Cold).
- **Symmetrix Last Fast IPT Time (Hot)** — Symmetrix Last Fast IPT Time (Hot).
- **Symmetrix Alerts (Enabled/Disabled)** — Symmetrix Alerts (Enabled/Disabled).
- **Max Capacity of DSE reservation** — not applicable to storage systems running HYPERMAX OS 5977.
- **Symmetrix Priority Controls** — not applicable to storage systems running HYPERMAX OS 5977.
- **Hot Swap Policy** — Hot Swap Policy.
- **Symmetrix Disk Library** — Symmetrix Disk Library
- **FBA Geometry Emulation** — FBA Geometry Emulation.
- **3 Dynamic Mirrors** — 3 Dynamic Mirrors.
Setting system attributes

Before you begin
Depending on the storage system operation environment, some of the following attributes may not apply.

Procedure
1. To set system attributes:
   1. Select the storage system.
   2. Select **System > Settings > Symmetrix Attributes**.
   3. Modify any number of the attributes.

Attributes are organized into the following panels:

- **General**:
  - **Hot Swap Policy**
    Specify whether to use global sparing:
    - **Permanent**
      Specifies that the spare drive become the active (permanent) drive. In this case, the data is not moved back to the drive that experienced the failure.
    - **Temporary**
      Specifies that once the failed drive is swapped, the spare copies all of the data back to the original drive and becomes spare again. This setting only applies to storage systems running Enginuity versions lower than 5876.
  - **VCMDB Access Restricted**
    Specify whether the VCM database can be accessed on this storage system. This is only applicable to for storage systems running Enginuity 5773.
    Select to enable, or clear to disable.

- **Enable Auto Meta**:
  This panel only displays for storage systems running Enginuity 5773 or 5876.
Enable Auto Meta
Select to enable, or clear to disable.
If Auto Meta is enabled, set the following properties:

Minimum Meta Capacity
Type the minimum volume size that will trigger the creation of a meta volume.
For Enginuity 5876 or higher, this value must be less than or equal to 525336 cylinders, if running in 32K compatibility mode; or 262669 cylinders, if running in native mode.

Member Capacity
Type the size of the meta members to use when creating meta volumes.

Configuration
Type the meta configuration as either Concatenated or Striped when creating meta volumes.
When enabled and attempting to create a volume larger than the value specified in the Minimum Meta Capacity field, or larger than 59 GB, it automatically triggers the creation of a meta volume according to the values specified in the Member Capacity and Configuration fields.

• PAV:
This panel only displays for storage systems with either ESCON or FICON directors.
Set the following parameters (z/OS only):

Alias Limit
Type the maximum number of aliases that can be assigned to a volume.

Mode
Select one of the following PAV types:

NoPAV
PAV not configured for the storage system.

Standard PAV
Volumes with static aliasing.

Dynamic Standard PAV
Standard PAV volumes with dynamic aliasing.

• SRDF/A:

Maximum Cache Usage (Percent)
Type the maximum percentage of system write-pending cache slots for all SRDF/A sessions. Valid values are 0 to 100.

Maximum Host Throttle (Secs)
Type the maximum percentage of system write-pending cache slots for all RDF/A sessions. Valid values are 0 to 65535.

• SRDF DIRECTORS:
These attribute settings control mixed I/O workloads on the same SRDF director.

**SRDF Director CPU Resource Distribution**
Whether the director CPU resource distribution feature is enabled or disabled.

**Synchronous I/O Percent**
Type the percentage of director resources to allocate for SRDF synchronous I/Os.

**Asynchronous I/O Percent**
Type the percentage of director resources to allocate for SRDF asynchronous I/Os.

**Copy I/O Percent**
Type the percentage of director resources to allocate for copy I/Os.

Percentages for synchronous, asynchronous, and copy I/O must add up to 100. Percentage values can be set even if the SRDF Director CPU Resource Distribution is disabled.

- **DCP:**

  **Cache Partition Status**
  Whether the dynamic cache partition feature is enabled, disabled, or in analyze mode.
  Analyze mode is a tool for determining the amount of cache your applications are consuming, prior to enabling the cache partitioning feature. For more on analyze mode, see Running in analyze mode on page 896.

  **Empty Partition Status**
  Whether to preserve or automatically remove empty cache partitions. By default, all empty partitions are removed if there is no partition configuration activity for 4 hours.

4. Click *Apply*.

### Viewing reservations

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
   
   Opens the system **Dashboard**.
3. In the **Summary** panel, click **View Reservations**.
   
   Use the **Reservations** list view to display and manage reservations for the storage system.

   The following properties display:

   - **Reservation**—Reservation ID.
   - **Owner**—User that created the reservation.
   - **Application**—Application used to create the reservation.
- **Host**—Host from which the reservation was created.
- **Reserved Volumes**—Number of reserved volumes.
- **Creation**—Date/time the reservation was created.
- **Expiration**—Date/time the reservation will expire. The default value is *Never*.
- **User Comment**—User-supplied comments.

The following controls are available:
- **Create**—Reserving volumes on page 341
- **View Details**—Viewing reservation details on page 344
- **Release**—Releasing reservations on page 343

---

## Using the Emulation Management wizard

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher.
- StorageAdmin or Admin authorization rights are required.
- A free director must be available at the required slot.
- The addition of directors of following types is not supported:
  - IM—Infrastructure Management
  - ED—Enginuity Data Services
  - DS—SAS back-end
  - DA—Fibre back-end
  - DX—External storage back-end
  - EF—FICON front-end

You can use the Emulation Management wizard to add and remove director emulations.

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Summary** panel, click **Emulation Management**.
4. On the **Options** page, select one of the following:
   - Add Director Emulation
     a. Click **Next**.
     b. On the **Configure** page, select values for the following:
        1. **Director Slot**
        2. **Director Emulation**
     c. Click **Next**.
   - Remove Director Emulation
     a. Click **Next**.
b. On the Configure page, select the emulation to remove.

c. Click Next.

5. On the Review page, review the details and do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 873 and Previewing jobs on page 873.
   
   Expand Add to Job List, and click Run Now to perform the operation now.

Setting CPU I/O resource distribution

Procedure

1. The following explains how to set parameters to control mixed I/O workloads on an SRDF director. Note that values specified here will override the default values defined in Setting system attributes on page 823.

   1. Select the storage system.
   2. Select System > System Dashboard.
   3. In the Hardware panel click RDF to open the RDF list view.
   4. Select an RDF director, and click CPU I/O Settings.
   5. Type values for any number of the following parameters. Note that the percentages must add up to 100.
      - Director Name—Type the director name.
      - Synchronous I/O Percent—Type the percentage of director resources to allocate for synchronous I/Os.
      - Asynchronous I/O Percent—Type the percentage of director resources to allocate for asynchronous I/Os.
      - Copy I/O Percent—Type the percentage of director resources to allocate for copy I/Os.

   6. To reset the parameters to their defaults, click Reset.

   7. Click OK.

Setting logging level preferences

This procedure explains how to configure the level of message to maintain in the Unisphere for VMAX log.

Procedure

1. Click in the title bar and select Settings.
2. Select a Logging Level.
3. Click OK.

Understanding eNAS

Embedded NAS (eNAS) integrates the file-based storage capabilities of VNX arrays into VMAX storage systems running HYPERMAX OS 5977 or higher.
With this integrated storage solution, Unisphere for VMAX StorageAdmin provision
VMAX storage to eNAS data movers, which triggers the creation of storage pools in
VNX. Unisphere for VNX users then use the storage pools for file-level provisioning
(for example, creating file systems, file shares, etc.)

Unisphere for VMAX provides the following features to support eNAS:

**File System dashboard**

Provides a central location from which to monitor and manage integrated VNX file
services. For more information, refer to Managing File storage on page 828.

**Provision Storage for File wizard**

Allows you to provision VMAX storage to eNAS data movers. For more
information, refer to Provisioning storage for file on page 830.

**Launch Unisphere for VNX**

Allows you to link and launch Unisphere for VNX. For more information, refer to
Launching Unisphere for VNX on page 832.

### Discovering eNAS control stations

**Before you begin**

- To perform this operation, you must be an Administrator.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to connect to an eNAS control station for the first time.

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard** to open the System dashboard.
3. In the **Summary** panel, click **File Dashboard** to open the **Credentials** dialog.
4. Type the username and password you use to access the eNAS control station and click **OK**.

### Managing File storage

**Before you begin**

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

The File dashboard provides you with a single place from which to monitor and
manage integrated VNX file services

**Procedure**

1. To access the File dashboard:
   1. Select the storage system.
   2. Select **System > System Dashboard**.
   3. In the **Summary** panel, click **File Dashboard**.
   4. If prompted, type the username and password you use to access the
eNAS control station, and click **OK**.

   The File dashboard provides a point-in-time view of the eNAS instance. To
   refresh the information displayed in the dashboard, click refresh storage system
   in the status bar, or exit/return to the dashboard.
The File dashboard

For more information about the elements of the File dashboard, refer to The File dashboard on page 829.

The File dashboard

The File dashboard is organized into the following panels:

- **Summary**
- **Capacity**
- **Most Consumed Capacity**
- **Common Tasks**
- **Control Stations**
- **Data Movers**
- **File Storage Alerts**

**Summary**

- **File Systems**—File systems associated with the file storage groups.
- **File Storage Groups**—File storage groups associated with the file systems.
- **File Masking Views**—Masking views associated with the file storage groups.

**Capacity**

Displays the following capacity information:

- **Virtual**—Free versus total capacities of the file storage groups.
- **File**—Free versus total capacities for the file systems associated with the file storage groups on the storage system.

**Most Consumed Capacity**

Displays the file storage pools with the most consumed capacity. To view a list of all file storage pools, regardless of their consumed capacity, click View All to open the Storage Pools list view.

**Common Tasks**

Links to common file storage tasks, including:

- **Provisioning storage for file** on page 830
- **Launching Unisphere for VNX** on page 832

**Control Stations**

Displays the name and status of the control stations.

**Data Movers**

Displays the status of the control station's data movers:

- **Name**—Data mover name.
- **Status**—Health status of the data mover.

**File Storage Alerts**

Details all alerts associated with the eNAS instance (file systems, storage groups, masking views), including:

- **Severity**—Alert severity. Possible values are:
  - (1) Fatal
(2) Critical
(3) Warning
(4) Information
(5) Normal
- **Description**—Description of the alert.
- **Created**—Date/time the alert was issued.

**Provisioning storage for file**

**Before you begin**
- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to provision VMAX storage to eNAS datamovers.

To provision storage for file:

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard** to open the **System** dashboard.
3. In the **Summary** panel, click **File Dashboard** to open the **File** dashboard.
4. If prompted, type the username and password you use to access the eNAS control station, and click **OK**.
5. In the **Common Tasks** panel, click **Provision Storage for File** to open the Provision Storage for File wizard.
6. Supply a **Storage Group Name**.
   
   Each storage group name is unique among the storage groups on the storage system and has up to 64 characters. Use only alphanumeric characters, underscores (_), and dashes (-) in the name. Storage group names are case-insensitive.

7. To select a **Storage Resource Pool** other than the default (DEFAULT_SRPO), click **Edit (📝)** and select one. To create the storage group outside of FAST control, select **None**.

8. Select the **Service Level** to set on the SG.

   Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None. Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
</tbody>
</table>
### Service level | Performance type | Use case
---|---|---
Optimized (default) |  | Places the most active data on the highest performing storage and the least active on the most cost-effective storage.

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

9. Refine the service level by selecting the **Workload Type** to assign to it.

10. Type the number of **Volumes** and select the **Capacity** of each.

11. (Optional) Click **Edit** and set any number of the following advanced options for the storage group:
   - To have FAST factor the R1 volume statistics into move decisions made for the R2 volume, select **RDF Coordination**.
     You can set this attribute on a storage group, even when there are no SRDF volumes in the storage group. This feature is only available if the storage system is part of an SRDF setup.
   - To allocate capacity for each SG volume, select **Allocate capacity for each volume**.
   - To persist preallocated capacity through reclaim or copy, select that check-box.

12. (Optional) To add a child storage group, do one of the following: click **Add Service Level** and
   - On all-flash storage systems, click **Add Storage Group**.
   - On all other storage systems, click **Add Service Level**.

Specify a **Name**, **Service Level**, **Workload Type**, **Volumes** and **Capacity**. Repeat this step for each additional child storage group. The maximum number of allowed child storage groups is 64.

13. (Optional) To set host I/O limits for the storage groups, click **Set Host I/O Limits** to open the **Host I/O Limits** dialog box. For information about setting the limits, refer to the dialog's help page.

14. Click **Next**.

15. (Optional) On the **Review** page of the wizard, follow these steps to manually set the LUN addresses for the masking operation:
   - a. Click **Set Dynamic LUNs** to open the **Set Dynamic LUN Addresses** dialog.
   - b. Note the address displayed in the **Starting LUN** field:
      - To accept this automatically generated address, click **Apply Starting LUN**.
      - To move to the next available, click **Next Available LUN**.
   - c. Click **OK**.

16. Click **Finish**.
Launching Unisphere for VNX

Before you begin
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
1. To launch Unisphere for VNX:
   1. Select the storage system.
   2. Select System > System Dashboard.
   3. In the Summary panel, click File Dashboard.
   4. If prompted, type the username and password you use to access the eNAS control station, and click OK.
   5. In the Common Tasks panel, click Launch Unisphere for VNX.

Managing file storage groups

Before you begin
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to manage file storage groups.

Procedure
1. Select the storage system.
2. Select System > System Dashboard to open the System dashboard.
3. In the Summary panel, click File Dashboard.
4. In the Summary panel, click File Storage Groups.
5. Select one or more storage groups and click one of the following, depending on the operation you want to perform:
   - Modify—Modifying storage groups on page 118
   - Provision Storage for File—Provisioning storage for file on page 830
   - View Details—Viewing storage group details (HYPERMAX OS 5977 or later) on page 140
   - FAST Array Advisor—Analyzing FAST migration on page 199
   - Change SRP—Changing Storage Resource Pools for storage groups on page 130
   - Delete—Deleting storage groups on page 136
   - Start Allocate/Free/Reclaim—Managing thin pool allocations on page 301 / Managing thin pool allocations on page 301 / Managing space reclamation on page 302
   - Stop Allocated/Free Reclaim—Managing thin pool allocations on page 301 / Managing thin pool allocations on page 301 / Managing space reclamation on page 302
   - Convert to Cascaded—Converting storage groups to cascaded on page 130
Managing file masking views

Before you begin

- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to manage file masking views.

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the Summary panel, click File Masking Views.
5. Select one or more masking views and click one of the following, depending on the operation you want to perform:
   - View Connections—Viewing masking view connections on page 396
   - Delete—Deleting masking views on page 395
   - View Details—Viewing masking view details on page 397

Viewing file systems

Before you begin

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view VNX file systems.

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the Summary panel, click File Systems to open the File Systems list view.

The following properties display:

- File System Name—Name of the file system.
- Storage Group(s)—Storage group(s) to which the file system belongs.
- Storage Pool—Storage pool to which the file system belongs. If the file system does not belong to a storage pool, the default name, Meta Volume, will display in this column.
- Allocated %—Allocated capacity of the file system in GB.
- Capacity (GB)—Total capacity of the file system in GB.

The following control is available:
- View Details—File System Details on page 834
Viewing file system details

Before you begin
- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view details on VNX file systems.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the Summary panel, click File Systems to open the File Systems list view.
5. Select a file system and click View Details to open its Details view.

For more information about the File Systems details view, refer to File System Details on page 834.

File System Details

The File System Details view contains Properties and Related Objects panels.

Properties panel
This panel contains:
- File System Name — Name of the file system.
- File System Description — Description of the file system.
- File System Unique ID — Unique VNX ID for the file system.
- File System Total Capacity (GB) — Size of the file system.
- File System Free Capacity (GB) — Available space on the file system.
- File System Block Size (Bytes) — Size of a block on the file system.
- File System Type — Type of file system and its conventions (for example, NTFS).
- Operational Status — Current operational status of the local file system.

Related Objects panel
The Related Objects panel links you to views displaying objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Storage Groups - 2 opens a view listing the storage groups associated with the file system.

Viewing file system storage pools

Before you begin
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view storage pools associated with VNX file systems.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the Summary panel, click File Systems.
5. Select a file system and click View Details.
6. In the Related Objects panel, click Storage Pools to open the Storage Pools list view.

The following properties display:
- **Storage Pool Name**—Name of the storage pool.
- **Instance ID**—Long name description of the storage pool.
- **#File Systems**—File system using the storage pool in a VNX context.
- **Health State**—Health state of the storage pool.
- **Storage Group**—Name of the storage group.
- **Allocated %**—Percentage allocated for the storage pool.
- **Capacity (GB)**—Capacity of the storage pool in gigabytes.

The following controls are available:
- **View Details**—Viewing file system storage pool details on page 835
- **Expand SG for File**—Modifying storage groups on page 118

**Viewing file system storage pool details**

Before you begin
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view storage pools associated with VNX file systems.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the panel, click File Dashboard.
4. In the Summary panel, click File Systems.
5. Select a file system and click View Details.
6. In the Related Objects panel, click Storage Pools to open the Storage Pools list view.
7. Select a storage pool and click View Details to open its details view.

For more information about the Storage Pools details view, see File system storage pool details on page 835.

**File system storage pool details**

The storage pools details view includes Properties, Related Objects, and File Systems panels.

Properties panel
This panel contains:
- **Name** — Name of the storage pool.
- **Instance ID** — Long name description of the storage pool.
- **Health State** — Current health of the storage pool. Values for this property are:
  - Unknown
  - OK
  - Degraded/Warning
  - Minor Failure
  - Major Failure
  - Non recoverable error
- **Total Managed Space (GB)** — Amount of capacity usable for allocation of storage volumes, logical disks, or child storage pools.
- **Remaining Managed Space (GB)** — Remaining usable capacity after allocation of storage volumes, logical disks, or child storage pools.
- **Operational Status** — Status for the operational condition of the pool. Values for this property are:
  - Unknown
  - Not Available
  - Servicing
  - Starting
  - Stopping
  - Abandoned
  - Dormant
  - Completed
  - Migrating
  - Emigrating
  - Immigrating
  - Snapshottling
  - Shutting Down
  - In Test
  - Transitioning
  - In Service
- **Pool ID** — Unique ID of the storage pool.
- **Primordial** — Whether the storage pool can be created by consumers of this model.
- **Usage** — Intended usage or any restrictions on the pool.

**Related Objects panel**
The **Related Objects** panel links you to views displaying objects contained in and associated with the storage pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Storage Groups** - 3 opens a view listing the three storage groups associated with the storage pool.

**File Systems panel**
This panel contains:
Manage file storage alerts

Viewing file storage alerts

Before you begin

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view alerts related to file storage.

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the File Storage Alerts panel, click View All to open the File Storage Alerts list view.

The following properties display:

- **State**—State of the alert. Available values are New or Acknowledged.
- **Severity**—Alert severity. Values of this property are:
  - (1) Fatal
  - (2) Critical
  - (3) Warning
  - (4) Information
  - (5) Normal
- **Type**—Type of alert. In this view, this property always contains File.
- **Object**—Object to which the alert is related. This field is blank for server alerts; server alerts are specific to the server or runtime environment and so are not associated with a specific object or storage system.
- **Description**—Description of the alert.
- **Created**—Date/time the alert was created.
- **Acknowledged**—Date/time the alert was acknowledged.

The following controls are available:

- **View Details**—Viewing file storage alert details on page 838
- **Acknowledge**—File system storage pool details on page 835
- **Delete**—Deleting file storage alerts on page 838
Viewing file storage alert details

Before you begin
- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view details on alerts related to file storage.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Summary panel, click File Dashboard.
4. In the File Storage Alerts panel, click View All.
5. Select an alert and click View Details to open the file storage Alert Details view.

The following properties display:
- Alert ID—Unique number assigned by Unisphere for VMAX.
- State—State of the alert. The value of this property is New or Acknowledged.
- Severity—Alert severity. Values are:
  - (1) Fatal
  - (2) Critical
  - (3) Warning
  - (4) Information
  - (5) Normal
- Type—Type of alert. The values of this property are Array, Performance, and System.
- Symmetrix—ID of the storage system generating the alert.
- Object—Object to which the alert is related. For more information, click the object to open its details view.
- Created—Date/time the alert was created.
- Description—Description of the alert.

The following controls are available:
- Acknowledge—Viewing file system storage pool details on page 835
- Delete—Deleting file storage alerts on page 838

Deleting file storage alerts

You can delete file storage alerts from the main Alerts list view or the File Storage Alerts view.

Procedure
1. Do one of the following:
   - To delete a file storage alert from the main Alerts list view, complete the following steps:
To delete a file storage alert from the File Storage Alerts view, complete the following steps:

a. Select the storage system.

b. Select System > Alerts to open the Alert list view.

c. Select one or more File type alerts and click Delete.

To delete a file storage alert from the File Storage Alerts view, complete the following steps:

a. Select the storage system.

b. Select System > System Dashboard.

c. In the Summary panel, click File Dashboard.

d. In the File Storage Alerts panel, click View All to open the File Storage Alerts list view.

e. Select one or more alerts and click Delete.

Viewing the system audit log

Before you begin

Because system audit logs can be very large, the list view opens pre-filtered to display the most recent 512 records. For information on filtering the listed records, refer to Filtering audit log records on page 841.

The user must have Auditor or higher permissions.

The storage system audit records come from the SYMAPI database and include all actions taken on that storage system. The audit log resides on the storage system and currently has a maximum size of 40 MB. Once the 40 MB limit is reached, the log begins to overwrite itself.

To view the system audit log:

Procedure

1. Select the storage system.

2. Select System > Audit Log to open the Audit Log list view.

   The following properties are displayed:

   Record
   Unique identifier for the audit entry.

   Date
   Date the audit entry was made.

   Application
   Application operating on the storage system.

   Username
   Name of the user operating on the storage system.

   Host
   Host operating on the storage system.

   Function Class
   Generic audit category for the operation on the storage system.

   Action Code
   Specific audit code for the operation on the storage system.
OS Name
Operating system running on the host.

Activity ID
Activity ID for audit record.

The following control is available:
View Details — Viewing Symmetrix audit log details on page 840

Viewing Symmetrix audit log details

To view details on a specific audit log record:

Procedure
1. Select the storage system.
2. Select System > Audit Log.
3. Select a record and click View Details to open its Details view.

The following properties display:

Record Number
Unique identifier for the audit entry.

Text
Summary of the Symmetrix operation.

Time
Date the audit entry was made.

Application ID
Application operating on the storage system.

Username
Name of the user operating on the storage system.

Function Class
Generic audit category for the operation on the storage system.

Action Code
Specific audit code for the operation on the storage system.

Host
Host operating on the storage system.

Records in Seq
One Symmetrix operation can be represented by a sequence of audit records. This is the total number of records in this particular audit sequence.

Offset in Seq
Audit entry number within the audit sequence.

Vendor ID
Vendor of the application operating on the storage system.
Application Version
Version of the application operating on the storage system.

API Library
SYMAPLI library type.

API Version
SYMAPI version number.

OS Name
Operating system running on the host.

OS Revision
Specific revision of the operating system.

Client Host
Client/Server only.

Activity ID
Activity ID for audit record.

Process ID
ID of the process that logged the record.

Task ID
ID of the task that logged the record.

Filtering audit log records
To filter the logs listed in an audit log list view:

Procedure
1. Click the filter icon to open the Auto Log Filter dialog box.
2. Select or type a value for any number of the following criteria, and then click OK:
   Range:
   
   By Date/By Record Number
   Specifies whether to filter the records by date/time or by record number and enables the appropriate fields.

   Start Date
   Specifies the start date and time to use in the range. Click the calendar icon to pick the date. Use the arrow controls to select the time. Select Earliest to set the Start Date to the date/time the first record was logged.

   End Date
   Specifies the end date and time to use in the range. Click the calendar icon to pick the date. Use the arrow controls to select the time. Select Latest to set the End Date to the date/time the last record was logged.

   Start Record
   Specifies the first record ID to use in the range.
End Record
Specifies the last record ID to use in the range.

Advanced Filtering:

Function Class
Filters the list for records with the specified audit category.

Action Code
Filters the list for records with the specified action code.

Activity ID
Filters the list for records with the specified activity ID.

Host
Filters the list for records logged by a specific host.

Vendor ID
Filters the list for records logged by a specific vendor.

Application ID
Filters the list for records logged by a specific application.

User Name
Filters the list for records logged by a specific user.

Affected Volumes
Filters the list for records logged by specific volumes.

3. To clear the filter, open the Audit Log Filter dialog box, click Clear All, and then OK.

**Viewing hardware components**

The System Hardware dashboard, allows you to view a system configuration and sub-components. From this view you can:

- View system components in a tree view or details view.
- View the current health or state of each system component.
- Control bay door LED blinking to identify a system bay. Includes instructions on using this feature.

To access the System Hardware dashboard:

**Procedure**

1. Select the storage system.
2. Select **System** > **System Dashboard**.
3. In the Health and Maintenance panel, click Symmetrix Hardware to open the System Hardware dashboard.

   The dashboard opens with the top-level system configuration as the default view.

4. Drill-down into the Hardware Components menu to view status and details on the system's components.
The health of each component is indicated with a status icon:

- 🟢—OK - component is healthy
- 🔴—Component health has degraded
- ⚠️—Component has failed

In the tree menu, component status is propagated up through the menu to the top system level. To locate a degraded or failed component, drill down to find the faulty component.

**Viewing available ports**

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **Available Ports**.

The **Available Ports** list view allows you to view and associate available ports with directors.

The following properties are displayed:

- **Slot**
  - Slot number.
- **Port**
  - Port ID.
- **Type**
  - Port type.
- **Speed**
  - Transmission rate (input/output channel).

The following control is available:

- **Associate**—**Associating directors and ports** on page 864

**Viewing back-end directors**

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **Back End** to open the Back End Directors list view.

Use this view to view and manage the back-end directors.

---

**Note**

Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

---

The following properties display:
Director
Director name.

Dir % Busy
Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

Type
Director type.

Hypers
Number of hyper volumes serviced by the director. This field only displays for storage systems running Enginuity 5773 or 5876.

Protocol
Transmission protocol for the director port.

Cores
Number of director cores. This field only displays for storage systems running HYPERMAX OS 5977 or higher.

Director Status
Director status.

Port Interface
Port interface ID. This field only displays for storage systems running Enginuity 5773 or 5876.

Port
Port ID. This field only displays for storage systems running HYPERMAX OS 5977 or higher.

Port Status
Indicates whether the port is online or offline.

Alerts
Indicates if there are alerts associated with the director.

The following controls are available:
• View Details—Viewing back-end director details on page 844

Viewing back-end director details

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Back End to open the Back End Directors list view.
4. Select a director from the list and click View Details to open the Back End Director details view.

The Back End Director details view allows you to view details on a back end director. This view contains Properties, Related Objects, and Performance Views panels.

In the Properties panel, the following properties display:
Director
   Director name.

Port Interface
   Port interface ID.

Type
   Director type.

Director Status
   Director status.

Director Serviced Hypers
   Number of hyper volumes serviced by the director.

Port Status
   Indicates port status, ON or OFF.

Port Serviced Hypers
   Number of hyper volumes serviced by the port.

The Related Objects panel links you to views displaying objects contained in and associated with the director. Each link is followed by a number, indicating the number of objects in the corresponding view.

The Performance Views panel links you to the performance monitor and analyze views for the director.

This panel displays only when the Performance option is installed. This panel displays with inactive links if the selected storage system is not registered for data collection.

Viewing external directors

Before you begin
External directors are supported only on storage systems running HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Other Hardware panel (bottom, right), click External Directors to open the External Directors list view.
   Use this view to view the external directors.

Note
Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:

Director
   Director name.

Port
   Port ID.
**Director Status**
Director status.

**Cores**
Number of available director cores.

**Hypers**
Number of hyper volumes serviced by the director.

**Alerts**
Director alert status, as indicated by icon color:
- ![Alert Symbol] One or more fatal alerts
- ![Alert Symbol] One or more critical alerts, with none higher
- ![Alert Symbol] One or more warning alerts, with none higher
- ![Alert Symbol] One or more informational alerts, with none higher
- ![Alert Symbol] No alerts

The following controls are available:
- **View Details**—Viewing external director details on page 846
- **Associate**—Associating directors with ports on page 861 (This control only displays when the storage system is running HYPERMAX OS 5977 or higher.)
- **Disassociate**—Disassociating directors and ports on page 864 (This control only displays when the storage system is running HYPERMAX OS 5977 or higher.)

**Viewing external director details**

**Procedure**
1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Other Hardware** panel (bottom, right), click **External Directors** to open the External Directors list view.
4. Select the director and click **View Details** to open its details view.

The external director details view allows you to view details on an external director. This view contains **Properties, Related Objects, Performance Views** panels.

The following properties display:
- **Director**
  Director name.
- **Port**
  Port ID.
**Type**
Director type.

**Director Status**
Director status.

**Port Status**
Indicates port status, ON or OFF.

**Number of Volumes**
Number of volumes serviced by the director.

**WWN**
Port WWN.

The **Related Objects** panel links you to views displaying objects associated with the director. Each link is followed by a number, indicating the number of objects in the corresponding view.

The **Performance Views** panel links you to the performance analyze views for the director.

This panel only displays when the Performance option is installed. This panel will display with inactive links if the selected storage system is not registered for data collection.

---

**Viewing system front-end directors**

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **Front End** to open the **Front End Directors** list view.

   Use this view to view and manage the front-end directors.

---

**Note**

Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

---

The following properties display:

**Director**
Director name.

**Port**
Port number.

**Alerts**
Director alert status, as indicated by icon color:

- ⚠️ One or more fatal alerts.
- 🔴 One or more critical alerts, with none higher.
- One or more warning alerts, with none higher.
- One or more informational alerts, with none higher.
- No alerts.

**Type**
Director transmission protocol.

**Director Status**
Whether the director is online or offline.

**Port Status**
Indicates whether the port is online or offline.

**Port ID**
Port ID.

**Volumes**
Number of volumes mapped to the director port.

**ACLX**
Indicates whether access control logic is enabled or disabled.

**Cores**
Number of cores. This field appears only when the storage system is running HYPERMAX OS 5977 or higher.

**Speed GB/Sec**
The speed of the individual cores on the system (applicable only to storage systems running HYPERMAX OS 5977 or higher).

**VCM State**
Indicates whether VCM volume state is enabled or disabled.

The following controls are available:
- **View Details**—Viewing system front end director details on page 849
- **Enable**—Enabling and disabling director ports on page 865
- **Disable**—Enabling and disabling director ports on page 865
- **Set Port Attributes**—Setting director port attributes on page 861
- **Convert FA to RF**—Converting directors on page 860 (not applicable to storage systems running HYPERMAX OS 5977 or higher.)
- **Set ORS Ceiling**—Setting Open Replicator ceiling on page 607
- **Map**—Mapping volumes on page 221 (Only enabled when ACLX is disabled)
- **Unmap**—Unmapping volumes on page 222 (Only enabled when ACLX is disabled)
- **Associate**—Associating directors with ports on page 861 (Only displays when the storage system is running HYPERMAX OS 5977 or higher.)
Disassociate—Disassociating directors and ports on page 864 (Only displays when the storage system is running HYPER MAX OS 5977 or higher.)

Viewing system front end director details

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Front End to open the Front End Director list view.
4. Select a director and click View Details to open the Front End Director details view.

The Front End Director details view allows you to view and manage a front end director. It contains Properties, Related Objects, and Performance Views panels.

The following properties display:

- **Director**
  - Director name

- **Dir % Busy**
  - Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

- **Port**
  - Port ID

- **Type**
  - Director transmission protocol

- **Director Status**
  - Director status

- **Port Status**
  - Indicates port status, ON or OFF

- **Director Connection Status**
  - Connection status.

- **Volumes**
  - Number of volumes mapped to the port.

- **Mapped Devices (including meta members)**
  - Number of mapped volumes, including any meta members.

- **Port ID**
  - Port ID.

- **Fibre Channel Loop**
  - Fibre channel loop.
VCM State
Indicates whether VCM is enabled or disabled. This option is only available on storage systems running Enginuity 5773.

ACLX
Indicates whether ACLX is enabled or disabled.

Common Serial Number
Indicates whether Common Serial Number feature is enabled or disabled.

Unique WWN
Indicates whether Unique WWN feature is enabled or disabled.

Init Point to Point
Indicates whether Init Point to Point is enabled or disabled.

Volume Set Addressing
Indicates whether Volume Set Addressing is enabled or disabled.

VNX Attached
Indicates whether VNX Attached is enabled or disabled.

Avoid Reset Broadcasting
Indicates whether Avoid Reset Broadcasting feature is enabled or disabled.

Negotiate Reset
Indicates whether Negotiate Reset feature is enabled or disabled. This feature is used for AS/400 systems only (default is off).

Enable Auto Negotiate
Indicates whether Enable Auto Negotiate feature is enabled or disabled.

Environ Set
Indicates whether environmental error reporting feature is enabled or disabled.

Disable Q Reset on UA
Indicates whether the Disable Q Reset on UA (Unit Attention) is enabled or disabled.

Soft Reset
Indicates whether Soft Reset feature is enabled or disabled for a Bull/GCOS-7 host.

SCSI 3
Indicates whether SCSI-3 protocol is enabled or disabled. When disabled, the SCSI 2 protocol is supported.

SCSI Support1(OS2007)
Indicates whether SCSI Support1 is enabled or disabled.

No Participating
Indicates whether Non Participate feature is enabled or disabled.
SPC2 Protocol Version
Indicates whether SPC Protocol Version feature is enabled or disabled. This feature is used for Windows 2003 environment running Microsoft HCT test version 12.1.

HP 3000 Mode
Indicates whether HP 3000 Mode is enabled or disabled. This feature is used for HP MPE 5.0 and Enginuity levels 5062 and earlier.

Sunapee
Indicates whether Sunapee feature is enabled or disabled. This feature is used for SUN PDB clusters.

Siemens
Indicates whether Siemens feature is enabled or disabled. This feature is used for Siemens R-series platforms.

Sequent
Indicates whether the Sequent feature is enable or disabled. This feature is used for Sequent platforms.

Server on AS400
Indicates whether Server of AS400 feature is enabled or disabled. This feature is used for AS/400 platforms.

Enable AS400
Indicates whether Enable AS400 is enabled or disabled.

OpenVMS
Indicates whether OpenVMS is enabled or disabled.

Open Replicator Maximum Ceiling (MB)
Maximum recopy ceiling value.

Open Replicator Ceiling (%)
Recopy ceiling value.

Open Replicator Actual Ceiling (MB)
Recopy actual ceiling value.

Negotiated Speed (GB/Second)
Negotiated speed in GB/Second.

The following controls are available:
- Enable—Enabling and disabling director ports on page 865
- Disable—Enabling and disabling director ports on page 865
- Set Port Attributes—Setting director port attributes on page 861
- Set ORS Ceiling—Setting Open Replicator ceiling on page 607

The Related Objects panel provides links to views for objects contained in and associated with the director. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Mapped Volumes - 2 opens a view listing the two volumes mapped to the director.

The Performance Views panel links you to the performance monitor and analyze views for the director.
This panel displays only when the Performance option is installed. This panel will display with inactive links if the selected storage system is not registered for data collection.

**Viewing RDF directors**

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **RDF** to open the RDF Directors list view.

Use this view to view and manage the RDF directors.

---

**Note**

Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:

- **Director**
  - Director ID.

- **Dir % Busy**
  - Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

- **Type**
  - Director type.

- **RDF groups**
  - Number of RDF groups.

- **Port**
  - Port ID.

- **Director Status**
  - Director status.

- **RDF Protocol**
  - Director transmission protocol.

- **IPSec Policies**
  - Number of IPSec Policies.

- **Port Status**
  - Indicates whether the port is online or offline.

- **Cores**
  - Number of cores. This field only displays when the storage system is running HYPERMAX OS 5977 or higher.

- **Alerts**
  - Director alert status, as indicated by icon color:
    - ⚠️ One or more fatal alerts.
One or more critical alerts, with none higher.

One or more warning alerts, with none higher.

One or more informational alerts, with none higher.

No alerts.

The following controls are available:

- **View Details**—Viewing RDF director details on page 853
- **Convert RF to FA**—Converting directors on page 860 (not applicable to storage systems running HYPERMAX OS 5977 or higher)
- **CPU I/O Setting**—Setting CPU I/O resource distribution on page 827
- **Associate**—Associating directors and ports on page 864 (only applicable to storage systems running HYPERMAX OS 5977 or higher)
- **Disassociate**—Disassociating directors and ports on page 864 (only applicable to storage systems running HYPERMAX OS 5977 or higher)

---

### Viewing RDF director details

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **RDF** to open the RDF Directors list view.
4. Select a director from the list and click **View Details** to open its details view.

The RDF Director details view allows you to view RDF director details. It contains **Properties**, **Related Objects**, and **Performance Views** panels.

The following properties display:

- **Director Identifier**
  - Director name.

- **Type**
  - Director type.

- **Director Status**
  - Director status.

- **Port**
  - Port ID.

- **WWN**
  - World wide name.

- **RDF (RA) Group Attributes - Farpoint**
  - Farpoint — Indicates whether this attribute is true or false.
Prevent Automatic RDF Link Recovery
Indicates whether preventing automatic link recovery is enabled or disabled.

Prevent RAs Online on Power Up
Indicates whether preventing RA to be online on power up is enabled or disabled.

Protocol Type
Director transmission protocol type.

RDF Software Compression Supported
Indicates whether RDF Software Compression is supported or not supported.

RDF Software Compression
Indicates whether RDF Software Compression is enabled or disabled.

RDF Hardware Compression Supported
Indicates whether RDF Hardware Compression is supported or not supported.

RDF Hardware Compression
Indicates whether RDF Hardware Compression is enabled or disabled.

Port Status
Indicates port status, ON or OFF.

IPV4 Address
IPV4 Address.

IPV6 Address
IPV6 Address.

IPV6 Prefix
IPV6 Prefix.

IPV4 Default Gateway
IPV4 Default Gateway.

IPV4 Domain Name
IPV4 Domain Name.

IPV4 Netmask
IPV4 Netmask.

SCSI Initiator Session
SCSI Initiator session.

Negotiated Speed (GB/Second)
Negotiated speed in GB/second.

Synchronous I/O Percent
Percentage of SRDF director CPU resources allocated to synchronous I/Os.
**Asynchronous I/O Percent**
Percentage of SRDF director CPU resources allocated to asynchronous I/Os.

**Copy I/O Percent**
Percentage of SRDF director CPU resources allocated to copy I/Os.

The **Related Objects** panel provides links to views for objects contained in and associated with the director. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **RDF Groups** - 2 opens a view listing the two RDF groups that the director is a member of.

The **Performance Views** panel links you to the performance monitor and analyze views for the RDF director.

This panel displays only when the Performance option is installed. This panel will display with inactive links if the selected storage system is not registered for data collection.

---

**Viewing RDF director SRDF groups**

**Procedure**

1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **RDF**.
4. Select a director and click **View Details** to open the **RDF Director Details** view.
5. In the **Related Objects** panel, click **RDF Groups** to open the RDF Groups list view.

Use this view to view the SRDF groups mapped to the front-end director.

The following properties display:

**SRDF Group**
- RDF group number.

**SRDF Group Label**
- RDF group label.

**Remote SRDF group**
- Remote RDF group number.

**Remote Symmetrix**
- Remote Symmetrix serial ID.

**Type**
- Whether volumes in the group are dynamic or static.

**Volume Count**
- Number of volumes in the group.

**Copy Jobs**
- Maximum number of RDF copy jobs per RDF group.

**Link Limbo (sec)**
- Number of seconds (0-10) for the Symmetrix system to continue checking the local RDF link status.
Minimum Cycle Time
Minimum time to wait before attempting an SRDF/A cycle switch. Values range from 5 to 59 seconds.

Session Priority
Priority used to determine which SRDF/A sessions to drop if cache becomes full. Values range from 1 to 64, with 1 being the highest priority (last to be dropped).

Transmit Idle Time
Time the transmit cycle has been idle.

Viewing IM directors

Before you begin
Infrastructure Manager (IM) directors are only supported on storage systems running HYPERMAX OS 5977 or higher.

Procedure
1. To view IM directors:
2. Select the storage system.
3. Select System > System Dashboard to open the system Dashboard.
4. In the Other Hardware panel, click IM directors to open the IM Directors list view.

The following properties display:

Note
Some of the following properties are environment-specific and therefore may appear in a different order or not at all.

- Director—Director name.
- Director Type—Director type.
- Director Status—Director status.
- Cores—Number of available director cores.
- Associated Ports—Number of associated ports.
- Alerts — Director alert status, as indicated by icon color:
  - One or more fatal alerts
  - One or more critical alerts, with none higher
  - One or more warning alerts, with none higher
  - One or more informational alerts, with none higher
Viewing EDS directors

Before you begin
Enginuity Data Services (EDS) directors are only supported on storage systems running Enginuity version 5977 or higher.

Procedure
1. To view EDS directors:
2. Select System > System Dashboard.
3. In the Other Hardware panel, click EDS directors to open the EDS Directors list view.

The following properties display:

Note
Some of the following properties are environment-specific and therefore may appear in a different order or not at all.

Director
Director name.

Dir % Busy
Percent of time the director is busy. This field only displays when the Symmetrix system is registered with the Performance component.

Director Type
Director type.

Director Status
Director status.

Cores
Number of available director cores. This field only displays when the Symmetrix system is running Enginuity version 5977 or higher.

Associated Ports
Number of associated ports.

Alerts
Director alert status, as indicated by icon color:

- ⚠️ One or more fatal alerts.
- 🔴 One or more critical alerts, with none higher.
- ⚠️ One or more warning alerts, with none higher.
Viewing failed drives

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Health and Maintenance panel (bottom, left) click Spare Drive Replacement to open the Spare Drive Replacement list view.

Use the Spare Drive Replacement list view to view and replace failed disk drives.

The following properties display:

- Disk Technology
  - Type of disk.
- Capacity
  - Usable disk capacity.
- Speed
  - Physical disk revolutions per minute.
- Spare Drive Count
  - Number of available spares.
- Block Size
  - Size of each disk block.

The following control is available:
- Replace—Replacing failed drives (Enginuity 5876) on page 867

Viewing mapped front-end volumes

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Front End Directors.
4. Select a director and click View Details.
5. In the Related Objects panel, click Mapped Volumes to open the Mapped Volumes list view.

Use this view to view the volumes mapped to the front-end director.

The following properties display:

- Name
  - Assigned volume name.
**Enginuity Warning dialog box**

This dialog box displays when one or more storage systems on which you have admin rights is running an Enginuity version below the minimum suggested version. In which case, you should contact your service provider to schedule an upgrade.

In addition to this dialog box, an alert will also display for each storage system not running the minimum suggested Enginuity version. For more information on viewing alerts, refer to Viewing alerts on page 52.

This dialog displays the following properties:

**Symmetrix**
- Storage system ID.

**Enginuity**
- Enginuity version currently running on the storage system.

**Date**
- Date the current Enginuity version was released.

**Target Enginuity**
- Minimum suggested Enginuity version for the storage system.*

**Target Date**
- Date the target Enginuity was released.*, **, ***

**Days Old**
- Number of days difference between the current Enginuity version and the target version. This field will appear empty when the current Enginuity version is at the end of life (EOL).*, **, ***

**Don't show this warning again for this release**
- Select this option to no longer view this warning for the corresponding storage system.

* This field will appear empty when the:
  - Enginuity version currently running on the storage system is the same as the **Target Enginuity** version and it is more than 180 Days Old.
• Enginuity version currently running on the storage system is lower than 5876 or higher than HYPERMAX OS 5977.

• Enginuity version currently running on the storage system is at the end of life (EOL). For more information on the EOL Enginuity versions, refer to the release notes.

  ** This field will appear empty when the Enginuity version currently running on the storage system is lower than the **Target Enginuity**.

  *** When the Enginuity version currently running on the storage system is more than 180 days older than the **Target Date, Days Old** displays the exact days old and the **Target Date** displays the target date.

### Converting directors

This procedure explains how to convert directors (FA to RF and from RF to FA).

#### Before you begin

This procedure requires Enginuity 5773 or 5876.

#### Procedure

1. To convert directors:
   1. Select a storage system.
   2. Select **System > System Dashboard** to open the System dashboard.
   3. Depending on the type of director you are converting, do the following in the **Hardware** panel:
      - **Front end directors:**
        a. Click **Front End** to open the Front End Directors list view.
        b. Select a director, click more **>>,** and click **Convert FA to RF** to open the **Convert Front End Director to RDF Director** dialog.
        c. To view additional information about the selected director, expand **Show Selected Directors**.
        d. Do either of the following:
           - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
           - Expand **Add to Job List**, and click **Run Now** to convert the director now.

      - **RDF directors:**
        a. Click **RDF** to open the RDF Directors list view.
        b. Select a director and click **Convert RF to FA** to open the **Convert RDF Director to Front End Director** dialog box.
        c. To view additional information about the selected director, expand **Show Selected Directors**.
        d. Do either of the following:
           - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.
Expand **Add to Job List**, and click **Run Now** to convert the director now.

4. (Optional) Open the Alerts list view (**System > Alerts**) to monitor the conversion process.

The following alerts are typical during a conversion:
- Director status has changed to Failed.
- Port state has changed to Offline.
- Port state has changed to Offline.
- Director state has changed to Online.
- Port state has changed to Not Present.
- Port state has changed to Online.

### Associating directors with ports

**Procedure**
1. Select the storage system.
2. Select **System > System Dashboard** to open the System dashboard.
3. In the **Hardware** panel, click **Available Ports** to open the Available Ports list view.
4. Select a port, click **Associate** to open the **Port Association** dialog.
5. Select a director and click **OK**.

### Setting director port attributes

**Procedure**
1. Select the storage system.
2. Select **System > System Dashboard** to open the System dashboard.
3. In the **Hardware** panel, click the type of director to open its list view.
4. Select the director, and click **Set Port Attributes** to open the **Set Port Attributes** dialog box.
5. (Optional) Select the port with the flag settings you want to copy.
6. Select or clear any number of the following attributes:

   **Note**
   The following attributes are for all port types. Therefore, depending on the port type, some of the attributes may not be available to you.

   **ACLX**
   Enables the port to be added to a port group.

   **Show ACLX Volume**
   Enables the display of ACLX volume.

   **Common Serial Number**
   Enables multi-path configurations or hosts that need a unique serial number to determine which paths lead to the same volume.
Unique WWN
Ensures unique World Wide Names (WWNs) within the fiber environment (uses Symmetrix serial numbers and port numbers). This is enabled by default for all environment configuration changes and new environments. When disabled, you don’t have to change WWNs.

Init Point to Point
Specifies a point-to-point (direct or switched) topology in the initialization sequence. When disabled (default), it is initialized as an arbitrated loop.

Volume Set Addressing
Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7.

The first digit must always be set to 0 (Symmetrix systems do not currently support the upper range of volume set addressing), the second digit is the VBus number, the third digit is the target, and the fourth digit is the LUN.

Avoid Reset Broadcast
Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

Negotiate Reset
When enabled for AS/400 hosts, this flag forces a SCSI negotiation by the Symmetrix system after a SCSI reset, an error, or a bus volume reset.

Enable Auto Negotiate
Allows two fibre ports to handshake and settle on an optimal speed for data transfer.

Environ Set
Enables the environmental error reporting by the Symmetrix system to the host on the specific port.

Disable Q Reset on UA
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

Soft Reset
Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

SCSI 3
Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

SCSI Support1
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.
Non Participating
Non participating.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

HP3000 Mode
Causes the Symmetrix port to return a SCSI busy state, instead of a 0B44 sense code when a xx3C error occurs. (Applies to HP MPE 5.0 and Enginuity 5062 and lower).

Sunapee
Enables the Sunapee option on the port, for SUN PDB clusters.

Siemens
Returns in the sense data error 0B48, instead of 0B44 for normal behavior. (Applies to Siemens R-series platforms only).

Sequent
Sets the task timeout window to be 15 seconds before aborting a process, and the Symmetrix system on the specified port does not force wide or synchronous negotiations. Also, a busy status returns, instead of a 0B44h when aborting a command on a timeout.

Server on AS400
Indicates the port is to behave as a server returning server inquiry data, rather than AS/400 data. (Applies to AS/400 platforms only).

Enable AS400
Indicates whether AS/400 is enabled.

OpenVMS
Enables an Open VMS fiber connection.

iSCSI IPv4 Address
Identifies the port's iSCSI IP address (IPv4).

iSCSI IPv4 Default Gateway
Identifies the port's default gateway address (iSCSI).

iSCSI IPv4 Netmask
Identifies the port's netmask address (iSCSI).

iSCSI Initiator Session
Identifies the port's initiator session ID (iSCSI).

iSCSI IPv6 Address
Identifies the port's iSCSI IP address (IPv6).

iSCSI IPv6 Net Prefix
Identifies the port's iSCSI net prefix (IPv6). Possible values range from 0 to 127. The default value is 64.
7. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 873 and **Previewing jobs** on page 873.

### Associating directors and ports

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

When associating directors and ports, you can associate directors with ports, or ports with directors.

**Procedure**

1. Do one of the following:
   - To associate directors with ports:
     a. Select the storage system.
     b. Select **System > System Dashboard**.
     c. In the **Hardware** panel, click **Available Ports** to open the **Available Ports** list view.
     d. Select one or more ports.
     e. Click **Associate** to open the **Associate Director** dialog box.
     f. Select a director and click **Associate**.
   - To associate ports with directors:
     a. Select the storage system.
     b. Select **System > System Dashboard**.
     c. In the appropriate panel (**Hardware** or **Other Hardware**), click the director emulation type to open its list view.
     d. Select the director.
     e. Click more **>>, and click **Associate** to open the **Port Association** dialog.
     f. Select the port and click OK.

### Disassociating directors and ports

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. To disassociate ports with directors:
   1. Select the storage system.
   2. Select **System > System Dashboard** to open the System dashboard.
   3. In the appropriate panel (**Hardware** or **Other Hardware**), click the director emulation type to open its list view.
   4. Select the director.
   5. Click more **>>, and click **Disassociate**.
6. Click Yes.

Enabling and disabling director ports

Procedure

1. Select the storage system.
2. Select System > System Dashboard to open the System dashboard.
3. In the Hardware panel, click the type of director to open its list view.
4. Select one or more ports, and click Enable to enable them, or Disable to disable them.
5. Click OK in the confirmation message.

Performing system health checks

Before you begin

- To perform this procedure you must be an Administrator or Storage Admin.
- The storage system must be running Enginuity 5876 or higher.

This procedure explains how to inspect the general state of a storage system.

Health check performs the following tests:

- **Vault State Test** — Verifies the ability of the system to save data in case of a power failure.
- **Spare Drive Test** — Verifies that spare drives are available in case of a drive failure.
- **Memory Test** — Verifies that the memory is reporting no errors or disabled banks.
- **Locks Test** — Verifies that there are no software locks present.
- **Emulations Test** — Verifies that all directors are loaded with the same Enginuity release as that on the service processor.
- **RDF Test** — Verifies that all SRDF links are online.
- **Environmental Test** — Verifies that internal environmental components (power supplies, fans, batteries, etc.) are reporting no errors.
- **Battery Test** — Verifies that the most-recent battery test reported no errors.
- **General Tests** — Checks for any abnormal conditions in the following areas: volume status, director status, hung upgrade, code table integrity, directors running same code.

To perform a health check on a storage system:

Procedure

1. Select a storage system.
2. Select System > System Dashboard to open the System dashboard.
3. In the Health and Maintenance panel, click Health Check.
   - The Health Check view opens displaying results of previously run health checks, if any.
4. Click Run.
5. Determine the health of the storage system by examining the Status and Results fields.
Naming storage systems

This procedure explains how to assign custom *nice names* to storage systems:

**Procedure**
1. Select a storage system.
2. Select System > System Dashboard to open the System dashboard.
3. In the Summary panel, click Symmetrix Details to open the Symmetrix Details view.
4. In the Array Display Name field, click either the existing name or Add Name to open the Set Array Display Name dialog box.
5. Type an Array Display Name. Array names must be unique from other array names and cannot exceed 32 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Array names are case-insensitive.
6. Click OK.

Locating VMAX systems

The following procedures explain how to locate a VMAX system by flashing/blinking its bay door lights.

With this feature you can either control the LEDs on all the bay doors or on individual bay doors.

**Before you begin:**

You cannot:
- Set the system bay LEDs to Blue Flash if any bay LED state is anything other than On. This feature is only available on storage systems running Enginuity 5876.
- Reset all LEDs when any LED state is N/A or Blink Fast.
- Set a bay LED to Slow Blink if any other bay LED is Off, Blink Slow, Fast Blink, or Blue Flash.
- Set a bay LED to On if the current LED state is anything other than Off, Blink Slow, or Blue Flash.

**Procedure**
1. Do one of the following:
   - To control all the bay LEDs:
     a. Select the storage system.
     b. Select System > System Dashboard.
     c. In the Health and Maintenance panel, click Symmetrix Hardware to open the Symmetrix dashboard.
     d. In the Hardware Components panel, right-click the Symmetrix system and select either of the following:
        - To set all of the system bay LEDs to Blue Flash, select Blue Flash On.
        - To reset all of the bay LEDs to the solid (On) state, select Reset all LEDs.
   - To control individual bay LEDs:
a. Select the storage system.

b. Select System > System Dashboard.

c. In the Health and Maintenance panel, click Symmetrix Hardware to open the System Hardware dashboard.

d. In the Hardware Components panel, right-click the component and select either of the following:
   - To blink the bay LED, select Blink On.
   - To reset the bay LED to the solid (On) state, select Blink Off.

Replacing failed drives (Enginuity 5876)

This procedure explains how to locate and replace failed VMAX disk drives.

Before you begin

- To perform this procedure you must be an Administrator or Storage Admin.
- The storage system with the failed disk drive must be locally attached to the SMAS server, running Enginuity 5876.163.105 or higher, and have the CRU flag enabled. This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.
- Ensure that there are no other disk replacements occurring on the storage system.
- Ensure that you have the replacement drive and storage system’s door key.

Note

Once you run the disk replacement job, you must replace the failed drive within 30 minutes to complete the disk replacement process. If you do not replace the drive within this time frame, the job will end, and you will need to restart the process.

The following are the high-level steps for completing this procedure:

Step 1: Locate the failed drive

Procedure

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Health and Maintenance panel, click Spare Drive Replacement.
4. Select the drive and click Replace.
5. Do one of the following:
   - Click Run Now to replace the drive now.
   - Expand Run Now and click Add to Job List to replace the drive at a later time, as described in .

Note

Regardless of the method you use to run the task, you have 30 minutes to locate and replace the failed drive. If you do not replace the drive within this time frame, the job ends, and you need to restart the process.

After you run the job, the Spare Drive Replacement Instructions dialog opens, displaying instructions and a map for locating the drive.
6. **Print** or **Export** the dialog contents, and then click **Close**.

7. Carefully follow the spare drive replacement instructions you just printed/exported to locate the drive.

**Step 2: Replace the failed drive**

**Before you begin**

It is recommended that before you begin any of the following procedures that you attach the clip of an ESD wristband to bare metal on the storage bay, and secure the wristband around your wrist with the metal button against your skin.

**Procedure**

1. To replace a failed disk drive:
   1. Access the disk drive. Do one the following, depending on the VMAX model:
      - **VMAX Series system:**
        a. Open the front door of the VMAX system and press the two spring latches on the DAE cover. Pull the cover outward and remove.
        b. Place the DAE cover aside for reinstallation later.
      - **VMAX SE system:**
        a. Open the front door of the VMAX system.
      - **VMAX 10K system:**
        a. Remove EMI front panel by pressing the side tabs and pulling straight forward.
2. Remove the disk drive:
   a. Release the latch on front of the disk you want to remove.
   b. Gently pull the disk out 1 inch and wait 30 seconds for the disk to stop spinning.
   c. Remove the disk and place it on an anti-static surface.

3. Install the disk drive:
   a. Align the drive with the guides in the slot.
   b. With the disk drive latch fully open, gently push the drive into the slot.
   c. Push the handle down to engage the latch. After the latch is engaged, push firmly on the bottom of the drive to verify that the disk is properly seated.
4. Reinstall the DAE cover or EMI front panel, or close the door, depending on the VMAX model:
   - VMAX Series system:
     a. Press the two spring latches on the DAE cover and align them with the slots on the chassis.
     b. Release the tabs to secure the cover. Close the front door of the storage bay.
   - VMAX SE system:
     a. Close the door.
   - VMAX 10K system:
     a. At the front of the cabinet, install the EMI front panel by pressing the side tabs and snapping into place.

Step 3: Verify the drive replacement

After you have completed the disk drive replacement, the lights will return to normal after several seconds. At this point, return to the Unisphere for VMAX console to ensure that the disk replacement completed without issues.

To verify that you successfully replaced the drive, look for the following message in the job list (for instructions on viewing the job list, refer to Viewing the job list on page 876):
Managing jobs

When you perform certain configuration tasks on the storage system, they are not immediately processed, but are kept in a job list for you to review and submit in batches. One way to identify these tasks is from the dialog boxes; they have a button named Add to Job List.

Unisphere for VMAX includes a job list view, from which you can view and manage the job list for a storage system.

Making configuration changes safely

Before making configuration changes, you must thoroughly understand your storage system configuration. The following guidelines establish safe disciplines as you begin any change that can impact stored data:

Verify that the current VMAX configuration is a viable configuration for making changes.

Before creating new volumes, check for free physical disk space. New storage volumes are created first on physical disks that have no prior allocations, causing these disks to be committed to that emulation type.

No configuration change is activated in the storage system until you commit the action.

Some classes of change operations may or may not impact current I/O. When possible, before you commit any action, stop I/O activity on the volumes to be altered during a configuration change session.

Ensure that all your critical data is preserved and safe when creating new or changing volume configurations. Do not store data on any volume that is not mirrored.

After committing a mapping operation, you must update the volume mapping information within the host system environment. Attempting host activity with a volume after it has been removed or altered, but before you have updated the host’s volume information, can cause host errors.

If I/O activity on an affected volume occurs before or during a commit action, the commit action might fail. At the very least, heavy I/O activity on unaffected volumes impacts how long it takes to commit changes.

Contact Customer Service for assistance in reverting to your previous configuration should there be unforeseen problems with the new configuration.

Understanding task persistence

Active Unisphere for VMAX configuration tasks persists across a server shutdown and subsequent restart. Inactive configuration tasks do not persist.

When the SMAS server is restarted, it restores all persisted tasks the task list, based on the user and the storage system.

The status of each restored task is determined by its status prior to the server shutdown, as detailed in the following table:
### Table 72 Task status before and after server shutdown

<table>
<thead>
<tr>
<th>Task status prior to server shutdown</th>
<th>Task status post server shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created</td>
<td>Created</td>
</tr>
<tr>
<td>Aborted</td>
<td>Created</td>
</tr>
<tr>
<td>Validated</td>
<td>Created</td>
</tr>
<tr>
<td>Running</td>
<td>Created</td>
</tr>
<tr>
<td>Successfully</td>
<td>Created</td>
</tr>
<tr>
<td>Run has error</td>
<td>Created</td>
</tr>
<tr>
<td>Prepare has error</td>
<td>Created</td>
</tr>
<tr>
<td>Submit has error</td>
<td>Created</td>
</tr>
<tr>
<td>Define has error</td>
<td>Created</td>
</tr>
<tr>
<td>Validate has error</td>
<td>Created</td>
</tr>
<tr>
<td>Done</td>
<td>Created</td>
</tr>
<tr>
<td>Failed</td>
<td>Created</td>
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<tr>
<td>Prepare in progress</td>
<td>Created</td>
</tr>
<tr>
<td>Abort in progress</td>
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<tr>
<td>Submitted</td>
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<tr>
<td>Prepared</td>
<td>Created</td>
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<tr>
<td>Defined</td>
<td>Created</td>
</tr>
<tr>
<td>Pending</td>
<td>Created</td>
</tr>
<tr>
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<td>Created</td>
</tr>
<tr>
<td>Acquiring lock</td>
<td>Created</td>
</tr>
<tr>
<td>Lock acquire failed</td>
<td>Created</td>
</tr>
<tr>
<td>Running</td>
<td>Created</td>
</tr>
<tr>
<td>During run</td>
<td>Created</td>
</tr>
<tr>
<td>During preview</td>
<td>Created</td>
</tr>
<tr>
<td>Commit in progress</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Note**

Configuration tasks that were in a Commit in progress state prior to server shutdown are restored in an Unknown state, since there is no way for the server to determine whether the task completed successfully. Therefore, to ensure that you are not committing a duplicate task, you should attempt to determine whether the original task completed successfully, prior to recommitting it.
Previewing jobs

Procedure

1. Select the storage system.
2. Select System > Job List to open the Job List view.

Scheduling jobs

This option can be schedule one-off jobs.

In addition, this option can be used to create a recurring daily SnapVX snapshot for a given time. There is also an option to cancel a recurring snapshot. In the event of a failed recurring snapshot, an Alert will be raised to notify the user. The schedule continues to run in the event of a failed snapshot, issuing alerts to the user. The alerts list view retains a record of the failed snapshots (unless the alert is deleted). A warning level alert is issued.

Note the following for SnapVX snapshot jobs:

- If the job is already scheduled to be recurring, then the job cannot be grouped.
- Unscheduled jobs can be grouped together and then a single recurring schedule can be applied to that group.
- You cannot edit a recurring schedule once it has been created. If you want to change a recurring schedule, you must delete the existing recurring schedule and set up a new recurring schedule.
- If you want to create more than one daily snapshot, for example, every Monday at 9AM create a snapshot and every Monday at 5PM create a snapshot, you have to schedule multiple jobs for the desired times, that is, re-run the Protection Wizard with SnapVX and add to job list and schedule the jobs for the additional times.
- When scheduling a weekly snapshot, it is recommended that you choose one day of the week and time to take the snapshot, for example, selecting Wednesday at 8AM in order for the snapshot to occur every Wednesday at 8AM.

Procedure

1. Select the storage system.
2. Select System > Job List.
3. Select a job and click View Details.
4. Click Schedule to open the Schedule dialog box.
5. Select an Execution Time and an Execution Date.
6. SnapVX Hourly snapshots only: Do one of the following: Select the Occurrence option—Daily, Hourly, or Run Once.
   - Daily: Select the Execution Time and select the days you want the job to reoccur on at the selected time.
   - Hourly: Select an Execution Time and an Execution Date.
   - Run Once: Select an Execution Time and an Execution Date.
7. Click OK.
8. Optional: Deleting a scheduled job
   - Select the job.
• Click View Details.
• Click Delete
• Click OK to confirm.

Running jobs

Procedure
1. Select the storage system.
2. Select **System > Job List** to open the Job List view.
3. Select a job and click Run.
4. Click OK.

Rescheduling jobs

Before you begin
You cannot reschedule a single task in a job, only the entire job.
If the volumes involved in a configuration change were originally reserved, rescheduling the tasks without reservation does not release the reservations. You need to manually release the reservations.

To reschedule a job:

Procedure
1. Select the storage system.
2. Select **System > Job List**.
3. Select a job and click **View Details**.
4. Click **Schedule** to open the **Schedule** dialog box.
5. Select a new **Execution Date** and **Execution Time**.
6. Click OK.

Renaming jobs

Procedure
1. Select the storage system.
2. Select **System > Job List**.
3. Select a job and click **View Details** to open its Details view.
4. Type a new name over the existing name and click **Apply**.
   Job names must be unique from other jobs on the storage system.

Reordering tasks within a job

Procedure
1. Select the storage system.
2. Select **System > Job List**.
3. Select a job and click **View Details** to open its Details view.
4. In the task list table, select the task, and click Move Up or Move Down.

**Grouping jobs**

This procedure explains how to group two or more jobs into one job.

**Procedure**

1. Select the storage system.
2. Select System > Job List.
3. Select two or more jobs, and click Group to open the Group Jobs dialog box.
4. Specify a Name for the New Job by doing one of the following:
   - Typing a name for the new job. Job names must be unique from other jobs on the storage system.
   - Selecting the name of one of the jobs to be grouped.
   - Use the default name, which is the next available short job ID selected by Unisphere for VMAX.
5. Click OK.

**Un-grouping jobs**

When un-grouping a job, Unisphere for VMAX creates an individual job for each of the tasks in the original job.

**Procedure**

1. Select the storage system.
2. Select System > Job List.
3. Select a job and click View Details.
4. In the task list, select Ungroup for each of the tasks you want to un-group from the job.

**Stopping jobs**

**Procedure**

1. Select the storage system.
2. Select System > Job List.
3. Select an active job and click Stop.
   - If Unisphere for VMAX successfully stops the job, the state of the job changes to Stopped.

**Deleting jobs**

This procedure explains how to group two or more jobs into one job.

**Procedure**

1. Select the storage system.
2. Select System > Job List to open the Job List view.
3. Select one or more jobs and click Delete.
4. Click OK.
Unisphere for VMAX removes the jobs from the job list view.

**Viewing the job list**

**Procedure**

1. Select the storage system.
2. Select **System > Job List** to open the Job List view.

   The Job List view allows you to view and manage a job list for a storage system.

   The following properties display:

   **Name**
   User-defined name for the job or an ID assigned by , and an icon indicating if the job contains one ( ) or more ( ) tasks.

   **Status**
   Status of the job. Possible values are:

   - **SCHEDULED**
     Job is scheduled for execution.

   - **CREATED**
     Job is created.

   - **RUNNING**
     Job is running. For jobs containing multiple tasks, this field will also display the job’s progress. For example, Running (2 of 10).

   - **SUCCEEDED**
     Job finished running.

   - **PENDING**
     Job is pending on the completion of another job.

   - **STOPPED**
     Job was running and a user stopped it.

   - **MISSED**
     Job was scheduled, but was never run.

   - **FAILED**
     Job failed.

   **User Name**
   Host from which the job was created and the ID of user who created it.

   **Last Modified Time**
   Date and time the job was moved to the job list.

   **Scheduled Time**
   Date and time the job is scheduled to run.

   **Completed Time**
   Date and time the job completed. This field is blank for incomplete jobs.
Recurring
Indicates whether the job is recurring.

The following controls are available:
- **Run** — Running jobs on page 874
- **View Details** — Viewing job details on page 877
- **Group** — Grouping jobs on page 875
- **Stop** — Stopping jobs on page 875
- **Delete** — Deleting jobs on page 875

### Viewing job details

**Procedure**

1. Select the storage system.
2. Select **System** > **Job List**.
3. Select a job and click **View Details**.

The following properties are displayed:

**Name**
User-defined name for the job or an ID assigned by . To rename the job, type a new name over the existing and click **Apply**. Job names must be unique from other jobs on the storage system.

**Status**
Status of the job. Possible values are:

- **Scheduled**
  Job is scheduled for execution.

- **Created**
  Job is created.

- **Running**
  Job is running. For jobs containing multiple tasks, this field will also display the job's progress. For example. Running (2 of 10).

- **Completed**
  Job finished running. This status displays for both succeeded and failed jobs.

- **Succeeded**
  Job succeeded.

- **Pending**
  Job is pending on the completion of another job.

- **Stopped**
  Job was running/appending and a user stopped it.

- **Missed**
  Job was scheduled, but was never run.
Error
   Job failed.

Scheduled
   Date and time the job is scheduled to run.

Owner
   Host from which the job was created and the ID of user who created it.

Last Modified
   Date and time the job was moved to the job list.

Completed
   Date and time the job completed. This field is blank for incomplete jobs.

Task list
   Lists the configuration tasks in the job.

Order
   Order in which the task will be executed in relation to the other tasks in the job.

Task
   Description of the task.

Move Up/Move Down
   Allows you to reorder the tasks in the job list by moving a selected task up/down.

Result
   Displays the config change steps as the job executes, and the results once the job finishes.

The following controls are available:
   • Run—Running jobs on page 874
   • Schedule—Scheduling jobs on page 873
   • Delete—Deleting jobs on page 875
   • Stop—Stopping jobs on page 875
   • Ungroup—Un-grouping jobs on page 875
   • Apply—Applies changes made in the job, for example, renaming the job.
   • Cancel— Cancels changes made in the details view.

Understanding licenses

Unisphere for VMAX supports Electronic Licensing (eLicensing). eLicensing is an end-to-end license management solution to help you track and comply with software license entitlement. eLicensing leverages embedded locking functions and back-office IT systems and processes. It provides you with better visibility into software assets, easier upgrade, and capacity planning and reduced risk of non-compliance, while still adhering to a strict “do no harm” policy to your operations.
When installing licenses with eLicensing, you obtain license files from customer service, copy them to a Solutions Enabler or a Unisphere for VMAX host, and load them onto storage systems.

Each license file fully defines all of the entitlements for a specific system, including its activation type (Individual or Enterprise), the licensed capacity, and the date the license was created. If you want to add a product title or increase the licensed capacity of an entitlement, obtain a new license file from online support and load it onto the storage system.

When managing licenses, Solutions Enabler, Unisphere for VMAX, z/OS Storage Manager (EzSM), MF SCF native command line, TPF, and IBM i platform console, provide detailed usage reports that enable you to better manage capacity and compliance planning.

There are two types of eLicenses: host-based and array-based. Host-based licenses, as the name implies, are installed on the host. And, array-based licenses are installed on the storage system. For information on the types of licenses and the features they activate, refer to the Solutions Enabler Installation Guide.

Unisphere for VMAX allows you to add and view array-based licenses, and add, view, and remove host-based licenses.

Unisphere for VMAX uses array-based eLicensing.

As a result, you can only manage a storage system from a Unisphere host, if the storage system contains a Unisphere for VMAX (SMC) eLicense. However, you can use Unisphere for VMAX to obtain and install the proper eLicense on the storage system.

Note

Storage systems that do not contain a Unisphere for VMAX (SMC) eLicense will display a Not licensed link in the Home section of the Unisphere for VMAX interface. To install a Unisphere for VMAX (SMC) eLicense on such a storage system, click the link and follow the instructions in Installing licenses on page 879.

Note

For more information on eLicensing, refer to the Solutions Enabler Installation Guide.

Installing licenses

Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.
- Before you can use Unisphere for VMAX to manage a storage system, you must first install a license on the system.
- To obtain array-based licenses from the support website you will need the License Authorization Code (LAC) identification number from the LAC letter emailed to you.

This procedure explains how to install VMAX and host-based licenses.

To install licenses:

Procedure

1. Select the storage system.
2. Select System > Settings > Electronic Licenses.
3. Do the following, depending on the license type:

Array-based licenses:

a. Click **Symmetrix Entitlements** to open the Symmetrix Entitlements list view.

b. Click **Get File** to open the support website, from which you can obtain new license files (by downloading or through email). Follow the instructions on the website. Be sure to download or copy the license file to a location on the SMAS server.

c. Click **Load File** to open the Load License File dialog.

d. Click **Browse** and select the license file.

e. (Optional) Click **Preview File** to preview the license file before loading it on the storage system.

f. Click **OK** to load the license file on the storage system.

Host-based licenses:

a. Click **Solutions Enabler** to open the Solutions Enabler license key list view.

b. Click **Load Key** to open the Load License Key dialog box.

c. Type the License Key.

d. Click **OK**.

### Removing host-based licenses

**Procedure**

1. Select the storage system.

2. Select **System > Settings > Electronic Licenses > Solutions Enabler** to open the Solutions Enabler license view.

3. Select the license and click **Remove Key**.

### Viewing Symmetrix entitlements

**Procedure**

1. Select the storage system.

2. Select **System > Settings > Electronic Licenses > Symmetrix Entitlements** to open the Symmetrix Entitlements list view.

   Use the **Symmetrix Entitlement** list to view all licensed features (including those licensed with array-based entitlements and host-based keys, which are still required) on storage systems running Enginuity 5876 or higher. In addition, you can obtain and install license files on storage systems running Enginuity 5876 or higher.

   The following properties display:

   **Feature Name**
   
   Name of the feature.

   **Activation Type**
   
   Whether the feature's license is Permanent or an Evaluation copy. Evaluation licenses include an expiration date for reporting purposes only;
the product title can still be used. Permanent licenses can be assigned to individual storage systems or to all the storage systems in the enterprise.

**Activation Domain Type**

Whether the permanent license is assigned to an individual storage systems or to all the storage systems in the enterprise. This column is blank for Evaluation type licenses.

**Activation ID**

Activation ID assigned to the license file.

**License**

Whether the license is host-based (SE) or array-based (EMCLM).

**Capacity Type**

Qualifies the capacity licensed. Possible values are:

- **R-TB-Non-SATA**
  
  Indicates that the capacity licensed applies to the raw capacity of all volumes on the system, excluding SATA. This value only applies to storage systems running Enginuity 5876.

- **R-TB-SATA**
  
  Indicates that the capacity licensed applies to the raw capacity of all SATA volumes on the system. This value only applies to storage systems running Enginuity 5876.

- **REG-TB**
  
  Indicates that the capacity licensed applies to the registered capacity of the storage system. This value only applies to storage systems running Enginuity 5876.

- **R-TB External**
  
  Indicates that the capacity licensed applies to the raw capacity of the virtualized LUNs in external storage. This value only applies to storage systems running Enginuity 5876.

- **Usable-TB**
  
  Indicates that the capacity licensed applies to the usable capacity of the storage system. This value only applies to storage systems running HYPERMAX OS 5977 or higher.

**Capacity (TB)**

Capacity licensed. The maximum quantity of data for which the functionality of the software is licensed to use, in Terabytes.

**Status**

Whether the license is Enabled or Disabled.

**Expiration Date**

Date an evaluation license expires. For permanent licenses, this field appears blank.

**Install Date**

Date the license file was installed on the storage system.

---

<table>
<thead>
<tr>
<th>Activation Domain Type</th>
<th>whether the permanent license is assigned to a single storage system or to all the storage systems in the enterprise. This column is blank for Evaluation type licenses.</th>
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</thead>
<tbody>
<tr>
<td>Activation ID</td>
<td>Activation ID assigned to the license file.</td>
</tr>
<tr>
<td>License</td>
<td>Whether the license is host-based (SE) or array-based (EMCLM).</td>
</tr>
<tr>
<td>Capacity Type</td>
<td>Qualifies the capacity licensed. Possible values are:</td>
</tr>
<tr>
<td></td>
<td><strong>R-TB-Non-SATA</strong> Indicates that the capacity licensed applies to the raw capacity of all volumes on the system, excluding SATA. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td></td>
<td><strong>R-TB-SATA</strong> Indicates that the capacity licensed applies to the raw capacity of all SATA volumes on the system. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td></td>
<td><strong>REG-TB</strong> Indicates that the capacity licensed applies to the registered capacity of the storage system. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td></td>
<td><strong>R-TB External</strong> Indicates that the capacity licensed applies to the raw capacity of the virtualized LUNs in external storage. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td></td>
<td><strong>Usable-TB</strong> Indicates that the capacity licensed applies to the usable capacity of the storage system. This value only applies to storage systems running HYPERMAX OS 5977 or higher.</td>
</tr>
<tr>
<td>Capacity (TB)</td>
<td>Capacity licensed. The maximum quantity of data for which the functionality of the software is licensed to use, in Terabytes.</td>
</tr>
<tr>
<td>Status</td>
<td>Whether the license is Enabled or Disabled.</td>
</tr>
<tr>
<td>Expiration Date</td>
<td>Date an evaluation license expires. For permanent licenses, this field appears blank.</td>
</tr>
<tr>
<td>Install Date</td>
<td>Date the license file was installed on the storage system.</td>
</tr>
</tbody>
</table>
The following controls are available:

- **View File**—Opens the license file installed on the storage system.
- **Get File**—Opens the support website, from which you can obtain a license file (by downloading or through email). Download or copy a license file to the SMAS server before applying it to a storage system.
- **Load File**—Installing licenses on page 879

### Viewing host-based licenses

**Before you begin**

**Procedure**

1. Select the storage system.
2. Select System > Settings > Electronic Licenses > Solutions Enabler to open the Solutions Enabler license view.

   The Solutions Enabler license view allows you to view and manage host-based licenses.

   The following properties display:

   - **License Key**
     - License key.
   - **Licensed Features**
     - Name of the licensed feature.

   The following controls are available:

   - **Load Key**—Installing licenses on page 879
   - **Remove Key**—Removing host-based licenses on page 880

### Viewing license usage

**Procedure**

1. Select the storage system.
2. Select System > Settings > Electronic Licenses > License Usage.

   The License Usage view shows the results of a query to the storage system's feature registration database (Enginuity 5876 or higher).

   The following properties display:

   - **Feature Name**
     - Name of the feature.
   - **Activation Type**
     - How the product title was activated. Possible values are:
     - **Entitlement**
       - Indicates that product title was activated through an entitlement.
     - **Manual Override**
       - Indicates that the product title was manually activated by customer service.
Product titles activated manually (MAN) or because they were in use (USE) are not considered properly entitled, in which case contact customer service for proper entitlement.

**Capacity Type**
Qualifies the licensed capacity. Valid values are:

- **R-TB-Non-SATA**
  Indicates that the capacity licensed applies to the raw capacity of all volumes on the system, excluding SATA.

- **R-TB-SATA**
  Indicates that the capacity licensed applies to the raw capacity of all SATA volumes on the system.

- **REG-TB**
  Indicates that the capacity licensed applies to the registered capacity of the storage system.

- **R-TB External**
  Indicates that the capacity licensed applies to the raw capacity of the virtualized LUNs in external storage.

**Licensed Capacity (TB)**
Maximum quantity of data for which the functionality of the software is licensed to use, in Terabytes.

**Used Capacity (TB)**
Amount of licensed capacity currently in use.

### Understanding access controls

Administrators, StorageAdmins, and SecurityAdmins can set access controls on specific volumes within a storage system and assign those volumes to a specific host. When set, only that host can see the volumes, and perform the granted operations. Other hosts connected to that storage system will not see those volumes. This eliminates the possibility of one host inadvertently performing operations on volumes that belong to someone else.

#### Note

Refer to the *Solutions Enabler Array Management CLI Product Guide* for more information about Access Controls.

To set up access controls:

**Procedure**

1. Create an access control group. See Creating access groups on page 884.
2. Add to the group, one or more hosts (access name) and unique IDs. Each host has a unique ID; a group can contain one or more hosts. See Adding access ID to access groups on page 885.
3. Create one or more pools of volumes.
Specific volumes can belong to only one pool. See Creating access groups on page 884.

4. Create one or more access control entries.
   An access control entry associates a pool with a group, and grants the access control types. See Viewing access control entries on page 890.

Opening access controls

Before you begin

Access control dialogs and views are restricted and require you to enter a PIN provided by customer service.

To perform this operation, you must be an Administrator or SecurityAdmin.

To open access controls:

Procedure

1. Select a storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. In the Access Control PIN Entry dialog box, do one of the following:
   - Select Read Only to gain read-only access to the Symmetrix Access Controls view.
   - Type the Access Control Pin.
4. Click OK.

Creating access groups

Typically various sets of users tend to use the same applications that utilize common features from a given host. They typically require the same volume resources and permissions of access to these shared volumes. For this reason, hosts are registered in groups identified with a group name, which serves as a root for all ACEs in the group. Access groups contain groups of access IDs and their ID names. Any ID and name must belong to just one group and are entered into the database together. For ease of management, it is highly recommended that you choose an access ID name that best associates with the particular host in use. For example, SunHost1 is more appropriate than a name such as JRSMITH.

Once the group is created, the group name can be used to create access control entries (ACEs).

To create an access control group:

Procedure

1. Select a storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin and click OK.
5. Click Create to open the Create Access ID Group dialog box.
6. Type a Group Name.

   Access group names must be unique from other access pools on the system and cannot exceed 31 characters (Enginuity 5773 or higher). Only alphanumeric
characters, underscores ( _ ), and dashes (-) are allowed. Access group names are case-sensitive.

7. Type the **Host ID**.
   This value is the name of the access ID (eight characters).

8. Type the host's **Unique Access ID**.
   To find this value, run the SYMCLI command symacl - unique on the host computer, (host ID example: 2C5E05B6-53408AC9-9C3F747C).

9. Click **Add Host**.
   This value is the name of the access ID (eight characters).

10. Click **OK**.

### Adding access ID to access groups

**Procedure**

1. Select the storage system.
2. Select **System > Settings > Symmetrix Access Controls**.
3. Type the **Access Control Pin** and click **OK**.
4. Click **Access Groups**.
5. Select the group and click **View Details**.
6. In the **Related Objects** panel, click **Access IDs**.
7. Click **Add** to open the **Add Access ID** dialog box.
8. Do one of the following:
   - To add host access IDs to the group:
     a. Type the **Host ID**. This value is the host computer name.
     b. Type the host's **Unique Access ID**. To find this value, run the SYMCLI command symacl - unique on the host computer. Example host ID: 2C5E05B6-53408AC9-9C3F747C.
     c. Click **Add Host**.
   - To add user access IDs to the group:
     a. Type the **User ID name**. This value is the ID assigned by the access control administrator, must be between four and twelve characters long.
     b. Type the user's access control pin.
     c. Click **Add User**.
9. Click **OK**.

### Removing access IDs from access groups

**Procedure**

1. Select the storage system.
2. Select **System > Settings > Symmetrix Access Controls**.
3. Type the **Access Control Pin** and click **OK**.
4. Click **Access Groups**.
5. Select the group and click View Details.
6. In the Related Objects panel, click Access IDs to open the Access ID list view.
7. Select one or more IDs and click Remove.
8. Click OK.

Deleting access groups

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin and click OK.
4. Click Access Groups to open the Access Groups list view.
5. Select one or more groups and click Delete.
6. Click OK.

Viewing access groups

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
5. Use the Access Groups list view to display and manage access groups on the storage system.

The following properties display:

Access ID Group
   Name of the access ID.

Number of Access IDs
   Number of members (host access IDs) in the group.

Number of Access Control Entries
   Number of access pools associated with the group.

The following controls are available:
- Create—Creating access groups on page 884
- View Details—Viewing access group details on page 886
- Delete—Deleting access groups on page 886

Viewing access group details

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
4. Click **Access Groups** to open the Access Groups list view.
5. Select the group and click **View Details** to open its details view.
6. Use the access group details view to display and manage an access group. This view contains the following panels:
   
   **Properties panel**
   The following properties display:
   
   **Access ID Group**
   Name of the access ID.
   
   **Number of Access IDs**
   Number of members (host access IDs) in the group.
   
   **Number of Access Control Entries**
   Number of access control pools associated with the group.
   
   The following controls are available:
   
   - **Create**—Creating access groups on page 884
   - **Delete**—Deleting access groups on page 886
   
   **Related Objects** panel
   The **Related Objects** panel provides links to views for objects contained in and associated with the access group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Access IDs - 2** opens a view listing the two access IDs in the group.

---

**Creating access pools**

**Procedure**

1. Select the storage system.
2. Select **System > Settings > Symmetrix Access Controls**.
3. Type the **Access Control Pin** and click **OK**.
4. Click **Access Pools**.
5. Click **Create** to open the **Create Access Controlled Volume Pool** dialog box.
6. Type a **Pool Name**.
   
   Access pool names must be unique from other access pools on the system and cannot exceed 31 characters (Enginuity 5773 or higher). Only alphanumeric characters, underscores ( _ ), and dashes (-) are allowed. Access pool names are case-sensitive.
   
   7. Select one or more **Available Volumes** and click **Add Volume**.
   
   **Note**
   
   When adding a meta volumes to an access pool, you must select the meta head. Individual meta members do not appear in the volume lists.
   
   8. Click **OK**.
Modifying access pools

The following explains how to add/remove volumes from an access pool:

Procedure

1. Select a storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin and click OK.
5. Select the access pool and click View Details to open its details view.
6. In the Related Objects panel, click Volumes to the access pool volumes list view.
   - To add volumes to the pool:
     a. Click Add to open the Add Volume to Access Pool dialog box.
     b. Select one or more Available Volumes and click Add Volume.
     c. Click OK.
   - To remove volumes from the pool:
     a. Select one or more volumes and click Remove.
     b. Click OK.

Deleting access pools

Procedure

1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin and click OK.
5. Select one or more pools and click Delete.
6. Click OK.

Viewing access pools

Procedure

1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
5. Use the Access Pools list view to display and manage access pools on the storage system.
   The following properties display:

   Access Controlled Volume Pool
   Name of the pool.

   Number of Volumes
   Number of volumes in the pool.
Number of Access Control Entries
Number of access control entries.

The following controls are available:

- **Create**—Creating access pools on page 887
- **View Details**—Viewing access pool details on page 889
- **Delete**—Deleting access pools on page 888

**Viewing access pool details**

**Procedure**

1. Select the storage system.
2. Select \texttt{System > Settings > Symmetrix Access Controls}.
3. Type the \texttt{Access Control Pin} or select \texttt{Read Only} and click \texttt{OK}.
4. Click \texttt{Access Pools} to open the Access Pools list view.
5. Select the access pool and click \texttt{View Details}.
6. Use the Access Pool details view to display and manage an access pool. This view contains two panels, \texttt{Properties}, and \texttt{Related Objects}.

**Properties panel**

The following properties display:

- **Access Controlled Volume Pool**
  The name of the pool.
- **Number of Volumes**
  Number of volumes in the pool.
- **Number of Access Controlled Entries**
  Number of access groups associated with the pool.

The following controls are available:

- **Create**—Creating access pools on page 887
- **Delete**—Deleting access pools on page 888

**Related Objects** panel

The \texttt{Related Objects} panel provides links to views for objects contained in and associated with the access pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking \texttt{Volumes - 2} opens a view listing the two volumes contained in the pool.

**Modifying access types**

The following explains how to add/remove access types defined in an access control entry.

**Procedure**

1. Select the storage system.
2. Select \texttt{System > Settings > Symmetrix Access Controls}. 
3. Type the Access Control Pin or select Read Only and click OK.
4. Click ACE to open the ACEs list view.
5. Select the entry and click View Details.
6. In the Related Objects panel, click Access Types to open the Access Types list view.
   • To add access types:
     a. Click Add to open the Assign Access Types dialog box.
     b. Select one or more access types and click Add. For more on the available access types, see Access types on page 893
     c. Click OK.
   • To remove access types:
     a. Select one or more access types and click Remove.
     b. Click OK.

Creating access control entries

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin.
4. Click ACEs.
5. Click Create to open the Create Access Control Entries dialog box.
6. Select/Create the access group to include in the ACE.
7. Select/Create the access pool to include in the ACE.
8. Select one or more Available Access Types and click Add Access Type.
9. Click OK.

Deleting access control entries

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
4. Click ACEs.
5. Select one or more entries and click Delete.
6. Click OK.

Viewing access control entries

Procedure
1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
4. Click ACEs.
5. Use the ACEs list view to display and manage access control entries on the storage system.

The following properties display:

**Access ID Group**
Associated access group.

**Access-controlled Volume Pool**
Associated access pool.

**Access Type**
Permissions assigned to the group/pool. For information about valid values, refer to Access types on page 893.

The following controls are available:

- **Create**—Creating access control entries on page 890
- **View Details**—Viewing access control entry details on page 891
- **Delete**—Deleting access control entries on page 890

---

**Viewing access control entry details**

**Procedure**

1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
4. Click ACEs.
5. Select an entry and click View Details
6. Use the ACE details view to list and manage access control entries. This view contains two panels, Properties and Related Objects.

**Properties panel**

The following properties display:

**Access ID Group**
Associated access group.

**Access-controlled Volume Pool**
Associated access pool.

**Access Type**
Permissions assigned to the group/pool. For possible values, see Access types on page 893.

The following controls are available:

- **Create**—Creating access control entries on page 890
- **Delete**—Deleting access control entries on page 890

**Related Objects** panel

The Related Objects panel provides links to views for objects contained in and associated with the access control entry. Each link is followed by a number,
indicating the number of objects in the corresponding view. For example, clicking **Access IDs - 2** opens a view listing the two access IDs associated with the entry.

**Viewing access IDs**

**Procedure**

1. Select the storage system.
2. Select **System > Settings > Symmetrix Access**
3. Type the **Access Control Pin** or select **Read Only** and click **OK**.
4. Click **Groups**.
5. Select the group and click **View Details**.
6. In the **Related Objects** panel, click **Access IDs**.
7. Use the Access ID list view to display and manage a access IDs.

The following property displays:

**Access ID**

Access IDs assigned to the group.

The following controls are available:

- **Add**—[Adding access ID to access groups](#)
- **Remove**—[Removing access IDs from access groups](#)

**Viewing access pool volumes**

**Procedure**

1. Select the storage system.
2. Select **System > Settings > Symmetrix Access Controls**.
3. Type the **Access Control Pin** or select **Read Only** and click **OK**.
4. Click **Access Pools**.
5. Select the access pool and click **View Details**.
6. In the **Related Objects** panel, click **Volumes**.
7. Use the Access Pool Volumes list view to display and manage the volumes in an access pool.

The following property displays:

**Volume ID**

Volume identifier.

The following controls are available:

- **Add**—[Modifying access pools](#)
- **Remove**—[Modifying access pools](#)
Viewing access types

Procedure

1. Select the storage system.
2. Select System > Settings > Symmetrix Access Controls.
3. Type the Access Control Pin or select Read Only and click OK.
4. Click ACEs.
5. Select an entry and click View Details.
6. In the Related Objects panel, click Access Types.
7. Use the Access Types list view to display and manage the access types associated with an access control entry.

The following property displays:

**Access Type**
Permissions assigned to the group/pool. For more information about valid values, refer to Access types on page 893.

The following controls are available:

- **Add**—Adding access ID to access groups on page 885
- **Remove**—Removing access IDs from access groups on page 885

Access types

This table lists/describes the possible access types. Access define the permissions assigned to access groups and pools.

<table>
<thead>
<tr>
<th>Access type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMIN</td>
<td>Grants administrator privilege to grant/deny access control entries to hosts and users.</td>
</tr>
<tr>
<td>ADMINRD</td>
<td>Grants read access only to all access control information.</td>
</tr>
<tr>
<td>ALL</td>
<td>All possible access types granted except ADMIN and ADMINRD. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>BASE</td>
<td>Allows the discovery of devices and to obtain states and statistics from the storage system (directors and volumes).</td>
</tr>
<tr>
<td>BASECTRL</td>
<td>Allows base control operations on volumes and device groups.</td>
</tr>
<tr>
<td>BCV</td>
<td>Allows TimeFinder (BCV) and clone control and status operations.</td>
</tr>
<tr>
<td>CACHCTRL</td>
<td>Allows cache control operations concerning LRU partition management.</td>
</tr>
</tbody>
</table>
Table 73 Access types (continued)

<table>
<thead>
<tr>
<th>Access type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFGDEV</td>
<td>Allows powerful configuration control operations that manage various types of configuration changes on volumes in the storage system.</td>
</tr>
<tr>
<td>CFGSYM</td>
<td>Allows access to set storage system attributes, set port flags, and swap RA groups. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>CHECKSUM</td>
<td>Allows volume Double Checksum operations.</td>
</tr>
<tr>
<td>CREATEDV</td>
<td>Allows the creation and deletion of volumes.</td>
</tr>
<tr>
<td>DIRCTRL</td>
<td>Allows you to take directors and their ports offline and online. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>ECC</td>
<td>Allows the ECC agent to run on the requested host.</td>
</tr>
<tr>
<td>OPTMZR</td>
<td>Allows user-configurable attributes that may affect the Optimizer behavior.</td>
</tr>
<tr>
<td>POWRPATH</td>
<td>Access to PowerPath-directed devices in an RDF group. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>QOS</td>
<td>Allows the execution of Quality of Service (QOS) performance control operations to manage copy priorities. Excludes LRU cache control functionality.</td>
</tr>
<tr>
<td>RCOPY</td>
<td>Manages Open Replicator sessions.</td>
</tr>
<tr>
<td>RDF</td>
<td>Allows SRDF control and set operations.</td>
</tr>
<tr>
<td>SDDF</td>
<td>Allows the DeltaMark (Change Tracker) functionality that monitors track changes.</td>
</tr>
<tr>
<td>SDR</td>
<td>Allows mapping/unmapping of devices to directors/ports for the Symmetrix Disk Reallocation (SDR) feature.</td>
</tr>
<tr>
<td>SNAP</td>
<td>Allows the creation and management of virtual copy sessions between a source volume and multiple virtual (VDEV) target volumes.</td>
</tr>
<tr>
<td>VLOGIX</td>
<td>Enables access to volume Masking or Volume Logix volumes.</td>
</tr>
</tbody>
</table>

Understanding dynamic cache partitioning

Dynamic Cache Partitioning (DCP) divides the cache memory into multiple partitions with unique names and their device path assignments. Partition areas can be made static or dynamic in size. The dynamic partitioning provides flexibility to the amount of floating memory that can be allocated with a high and low watermark. This allows memory resources to be temporarily donated to other partitions when needed. The
The `symqos` command allows you to create partitions for different device groupings in addition to the default partition that all devices belong to initially. Each partition has a target cache percentage as well as a minimum and maximum percentage. In addition, you can donate unused cache to other partitions after a specified donation time.

**Note**

Enginuity 5773 or 5876 are required for actively managing dynamic cache partitions. DCPs can be viewed on VMAX3 arrays running HYPERMAX OS 5977 Q316SR or higher but they can't be actively managed.

### Enabling/Disabling dynamic cache partitioning

**Before you begin**

This feature is not supported on HYPERMAX OS 5977 or higher.

**Procedure**

1. Select a storage system.
2. Select `System` > `Settings` > `Symmetrix Attributes` to open the `Symmetrix Attributes` panel.
3. In the DCP panel, set the `Cache Partition Status` to `Enable`.
4. Click `Apply`.

### Creating dynamic cache partitions

**Before you begin**

- This feature is not supported on HYPERMAX OS 5977 or higher.
- There must be an available partition.
- There must be enough cache left in the default partition that it does not fall below the minimum required cache.
- The number of cache partitions allowed on a storage system is defined in the storage system's properties file. The maximum number allowed is 16.
- The sum of target % for all defined partitions must be 100%.

**Procedure**

1. Select the storage system.
2. Select `System` > `System Dashboard`.
3. In the `Hardware` panel click `Cache Partitions`.
4. Click `Create` to open the `Create Dynamic Cache Partition` dialog box.
5. Type a `Name` for the dynamic cache partition.
6. Type the minimum target percentage (`Min Target %`) for the partition. This value must be less than the Target %.
7. Type the target cache percentage (`Target %`) for the partition. This value must be less than the Max Target %.
8. Type the maximum cache percentage (Max Target %) for the partition.
9. Type the Donation Time in seconds.
   This value is the length of time before idle cache will be made available to other
   partitions. The default value is 300 seconds.
10. Type the write pending limit percentage (WP Limit %) for the cache partition.
    Possible values 40-80, with 80 being the default.
11. Click OK.

Assigning dynamic cache partitions

Before you begin
This feature is not supported on HYPERMAX OS 5977 or higher.

This procedure explains how to assign dynamic cache partitions from the Volumes
view. You can also perform this operation from other locations in the interface.
Depending on the location, some of the steps may not apply.

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
3. Locate the volumes using the volumes filter (HYPERMAX OS 5977 or higher),
   or the tree menu in the Volumes dashboard (Enginuity 5773, 5876). For
   information on using these components, refer to Managing volumes
   (HYPERMAX OS 5977 or higher) on page 203 and Managing volumes
   (Enginuity 5773 or 5876) on page 204.
4. Select the volumes, click more >>, and select Assign Dynamic Cache
   Partition to open the Assign Dynamic Cache Partition dialog box.
5. (Optional) Click Show Selected Volumes to view details on the selected
   volumes.
6. Select a Dynamic Cache Partition and click OK.
7. Click OK.

Deleting dynamic cache partitions

Before you begin
This feature is not supported on HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Cache Partitions to open the Cache Partitions list
   view.
4. Select a partition and click Delete.
5. Click OK in the confirmation message.

Running in analyze mode

Cache partitioning Analyze mode is a tool for helping you determine the amount of
cache your applications are consuming, prior to enabling the cache partitioning
feature. Once you have determined the amount of cache your applications are consuming, you can then modify the existing partitions, or add/delete partitions to achieve the required performance.

Enabling Analyze mode will automatically set the following cache partition settings:

- Max % = 100
- Min % = 0
- Donation Time = 0 (seconds)

These settings will allow cache to behave as if there are no partitions.

**Procedure**

1. Enable dynamic cache partitioning in Analyze mode.
2. Create your dynamic cache partitions. See Creating dynamic cache partitions on page 895.
3. Assign volumes to the cache partitions.
5. Once you have gathered enough usage data, change the cache partitioning status from Analyze mode to Enable.
6. Make changes to the cache partitions based on the usage data.

**Viewing dynamic cache partitions**

**Procedure**

1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Cache Partitions.

Use the Cache Partitions list view to display and manage dynamic cache partitions.

The following properties display:

- **Name**
  - Name of the partition.

- **Min %**
  - Minimum target percentage.

- **Tgt %**
  - Target cache percentage.

- **Max %**
  - Maximum cache percentage.

- **Donation Time**
  - Length of time before idle cache will be made available to other partitions.

- **WP Limit**
  - Write pending limit percentage.

- **Slots Used**
  - Number of cache slots used by the partition.

- **% Used**
  - Percentage of cache used by the partition.
Alerts
Director alert status, as indicated by icon color:

- ⚠️ One or more fatal alerts.
- 🚨 One or more critical alerts, with none higher.
- ⏰ One or more warning alerts, with none higher.
- 🔄 One or more informational alerts, with none higher.
- ⚫ No alerts.

The following controls are available:
- **Create**—Creating dynamic cache partitions on page 895
- **View Details**—Viewing dynamic cache partitions on page 897
- **Delete**—Deleting dynamic cache partitions on page 896

**Viewing dynamic cache partition details**

**Procedure**
1. Select the storage system.
2. Select **System > System Dashboard**.
3. In the **Hardware** panel, click **Cache Partitions** to open the Cache Partitions list view.
4. Select a partition and click **View Details**.

   The Cache Partition details view allows you to view and manage a cache partition. This view contains **Properties**, **Related Objects**, and **Performance Views** panels.

   The following properties display:

**Name**
Name of the partition. To rename the partition, type a new name over the existing and click **Apply**. Dynamic cache partition names must be unique from other cache partition names on the storage system and cannot exceed 32 characters. Only alphanumeric characters and underscores are allowed. Note that underscores can only be used with the string; not on the ends of the string. You cannot modify the name of the DEFAULT_PARTITION.

**Min Target %**
Minimum target percentage. To change this value, type a new value over it and click **Apply**. This values must be less than the Target %. You cannot modify this value for the DEFAULT_PARTITION.

**Target %**
Target cache percentage.
To change this value, type a new value over it and click Apply. This value must be less than the Max Target %. You cannot modify this value for the DEFAULT_PARTITION.

Max Target %
Maximum cache percentage.
To change this value, type a new value over it and click Apply. You cannot modify this value for the DEFAULT_PARTITION.

Donation Time (Sec)
Length of time before idle cache will be made available to other partitions.
To change this value, type a new value over it and click Apply.

Write Pending Limit (%)
Write pending limit percentage.
Possible values 40-80, with 80 being the default.

Write Pending Slot Count
Write pending slot count.

Cache Slots Used
Number of cache slots used by the partition.

Cache Percentage Used
Percentage of cached used by the partition.

The following controls are available:
- **Create** (Only available on storage systems running Enginuity 5773 or 5876) — Creating dynamic cache partitions on page 895
- **Delete** (Only available on storage systems running Enginuity 5773 or 5876) — Deleting dynamic cache partitions on page 896
- **Apply**—Applies changes made in the Properties panel.
- **Cancel**—Cancels changes made in the Properties panel.

The Related Objects panel provides links to views for objects contained in and associated with the cache partition. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking Volumes - 2 opens a view listing the two volumes contained in the cache partition.

The Performance panel links you to the performance analyze views for the group.

This panel displays with inactive links if the selected storage system is not registered for data collection.

**Viewing volumes assigned to dynamic cache partitions**

**Procedure**
1. Select the storage system.
2. Select System > System Dashboard.
3. In the Hardware panel, click Dynamic Cache Partitions to open the Dynamic Cache Partitions list view.
4. Select a partition and click **View Details** to open its **Details** view.

5. In the **Related Objects** panel, click **Volumes** to open the **Volumes** list view.

   Use the **Volumes** list view to display and manage volumes assigned to the partition.

   The following properties display:
   - **Name**—Assigned volume name.
   - **Type**—Type of volume.
   - **Meta Config**—Volume configuration.
   - **Striped Size**—Meta striped size.
   - **Status**—Volume status.
   - **Reserved**—Indicates whether the volume is reserved.
   - **Capacity (GB)**—Volume capacity in Gigabytes.
   - **Emulation**—Emulation type for the volume.
   - **Paths**—Number of masking records for the volume.

The following controls are available:

- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 234

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**System management - iSCSI**

Unisphere for VMAX provides monitoring and management for Internet Small Computer Systems Interface (iSCSI) directors, iSCSI ports, iSCSI targets, IP interfaces, and IP routes on storage systems running HYPERMAX OS 5977 or higher.

iSCSI is a protocol that uses the TCP to transport SCSI commands, enabling the use of the existing TCP/IP networking infrastructure as a SAN. As with SCSI over Fibre Channel (FC), iSCSI presents SCSI targets and devices to iSCSI initiators (requesters). Unlike NAS, which presents devices at the file level, iSCSI makes block devices available via the network. Block devices are presented across an IP network to your local system. These can be consumed in the same way as any other block storage device.

The iSCSI changes address the market needs originating from cloud/service provider space, where a slice of infrastructure, for example, compute, network and storage, is assigned to different users (tenants). Control and isolation of resources in this environment is achieved by the iSCSI changes. In addition, more traditional IT enterprise environments also benefit from this new functionality. The changes also provide greater scalability and security.

The iSCSI dashboard provides you with a graphical view of the relationship between an iSCSI director and its associated iSCSI ports, iSCSI targets, IP interfaces and IP routes. From the dashboard, you can navigate to monitor and manage iSCSI directors, iSCSI ports, iSCSI targets, IP interfaces and IP routes.

To view the iSCSI dashboard

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard** to open the iSCSI dashboard.
The following panels display:

- **iSCSI DIRECTORS** — A panel
  - displaying the overall number of and relationships between the iSCSI objects: iSCSI Directors, unattached iSCSI Targets, attached iSCSI Targets, iSCSI Ports, IP Routes, and IP Interfaces. Clicking on an item opens the associated list view.
  - listing the iSCSI directors. The status of the iSCSI director is represented by an icon that is based on the alerts for the director. Clicking All Items results in the relationship panel displaying all iSCSI Directors. Selecting a specific director results in an update to relationship panel to display director information for the selected director.

- **iSCSI Management** — A panel with the following controls:
  - Create iSCSI Target — Creating an iSCSI target on page 901
  - Create IP Interface — Creating an IP interface on page 903
  - Add IP Route — Adding an IP route on page 903

- **iSCSI Alerts** — A panel listing the latest alerts listing the associated object, description and creation date/time. Click View All to view all alerts.
  
  The following properties display:

  - **State**
    The state of the alert.

  - **Severity**
    The severity of the alert.

  - **Type**
    The alert type.

  - **Object**
    The object associated with the alert.

  - **Description**
    The description of the alert.

  - **Created**
    Date/time the alert was created.

  - **Acknowledged**
    The date and time that the alert was acknowledged.

---

**Creating an iSCSI target**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard**.
3. Click **iSCSI Targets** (Attached or Unattached) to open the (Attached or Unattached) iSCSI Targets list view.
4. Click **Create**.
5. Select a director from the drop-down menu.
6. (Optional) (Optional) Select the **Use custom name** check box and then type a value for the **Target Name**.
If you do not enter a value, the system generates a unique iqn for the target name. If you enter a value, it must start with 'iqn.' or 'eui.' strings, be composed of alphanumeric characters, colons, dashes, and periods, not be longer than 255 characters, and be unique on the storage system.

7. Type a value for the Network ID.
   Valid values range from 1 through 16383.

8. Type a value for the TCP Port.
   Default value is 3260. Valid values range from 0 through 65535.

9. (Optional) Click Show Advanced to view the port properties advanced section for the iSCSI target.
   a. Select one or more of the following Port Flags:

   **Volume Set Addressing**
   Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

   **Environ Set**
   Enables the environmental error reporting by the storage system to the host on the specific port.

   **Avoid Reset Broadcast**
   Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

   **Disable Q Reset on UA**
   When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

   **Soft Reset**
   Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

   **SCSI 3**
   Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

   **SCSI Support1**
   Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

   **SPC2 Protocol Version**
   This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

   **Open VMS**
   Enables an Open VMS fiber connection.
ISID Protected
Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on iSCSI target, the system uses the ISID and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.

10. Click OK.

Creating an IP interface

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click IP Interface.
4. Click Create.
5. Select a director and port combination from the drop-down menu.
6. Type a value for the IP Address.
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format. The IP address must be unique within a SE Director Emulation/Network ID combination.
7. Type a value for the Prefix.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.
8. Type the value for the Network ID.
   Valid values range from 1 through 16383.
9. Type a value for the VLAN ID.
   Valid values range from 0 through 4094. This setting fails if same VLAN id is used for more than one IP interface on a specified SE physical port.
10. (Optional) Type a value for the Max Transmission Unit.
    Default value is 1500. Valid values range from 1500 through 9000.
11. Click OK.

Adding an IP route

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click IP Route.
4. Click Add IP Route.
5. Select a director and port combination from the drop-down menu.
6. Type a value for the Destination IP:
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.
7. Type a value for the **Prefix**.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.

8. Type a value for the **Gateway IP**.
   You specify an IPv4 or IPv6 address. You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.

9. (Optional) Type the value for the **Network ID**.
   Default value is 1. Valid values range from 1 through 16383.

10. Click **OK**.

**Deleting an iSCSI target**

Deleting iSCSI targets with IP interfaces attached detaches the IP interfaces before deleting the iSCSI target.

The deletion fails if the target is in a port group.

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard** to open the iSCSI dashboard.
3. Click **iSCSI Targets** (Attached or Unattached).
4. Select an iSCSI target and click **Delete**.
5. Click **OK**.

**Deleting an IP interface**

---

**Note**

An IP interface attached to an iSCSI target cannot be deleted.

---

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard** to open the iSCSI dashboard.
3. Click **IP Interfaces** to open the IP Interfaces list view.
4. Select an IP interface and click **Delete**.
5. Click **Yes** to confirm the operation.

**Removing an IP route**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard** to open the iSCSI dashboard.
3. Click **IP Routes** to open the IP Routes list view.
4. Select an IP route and click **Remove**.
5. Click **Yes** to confirm the operation.
Attaching an IP interface to an iSCSI target

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > ISCSI Dashboard to open the iSCSI dashboard.
3. Click IP Interface.
4. Select an IP interface and click Attach.
5. Select whether to attach to an existing or new iSCSI target, and do one of the following depending on your selection:
   - Existing:
     a. Select an iSCSI target from the list filtered by network ID and director.
   - New:
     a. Click Use Custom Name and type a value for the Target Name. If you do not enter a value, the system generates a unique iqn for the target name. If you enter a value, it must start with 'iqn.' or 'eui.' strings, be composed of alphanumeric characters, colons, dashes, and periods, not be longer than 255 characters, and be unique on the storage system.
     b. Optional: Type a value for TCP Port. The default value is 3260. Valid values range from 0 through 65535.
     c. Optional: Click Show Advanced to display the port flag properties for the target being created. Select one or more of the following Port Flags:

   Volume Set Addressing
   Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

   Environ Set
   Enables the environmental error reporting by the storage system to the host on the specific port.

   Avoid Reset Broadcast
   Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

   Disable Q Reset on UA
   When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

   Soft Reset
   Supports SCSI soft reset on a VMAX port when enabled for a Bull/GCOS-7 host.

   SCSI 3
   Alters the inquiry data (when returned by any volume on the port) to report that the VMAX system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.
SCSI Support
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

Open VMS
Enables an Open VMS fiber connection.

ISID Protected
Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on iSCSI target, the system uses the ISI and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.

6. Click OK.
   If you toggle between the New and Existing selections, the system only applies the changes from within your last selection.

7. Click OK to confirm your changes.

Attaching an iSCSI target to an IP interface

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > ISCSI Dashboard to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached) to open the iSCSI Targets list view.
4. Select an iSCSI target and click Attach.
5. Select whether to use an existing or new IP interface(s), and do one of the following depending on your selection:
   a. Existing:
      a. Select an IP interface from the list.
         You can select a maximum of 8 interfaces (the total (8) includes the number of already attached interfaces).
   b. New:
      a. Select a director and port combination from the drop-down menu.
      b. Type a value for the IP Address.
         You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.
      c. Type a value for the Prefix.
         You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.
      d. Type a value for the VLAN ID.
Valid values range from 0 through 4094. This setting will fail if same VLAN id is used for more than one IP interface on a specified SE physical port.

e. View the value for the **Network ID**.
   Value displayed is based on the existing target selection.

f. Optional: Type a value for the **Max Transmission Unit**.
   The default value is 1500. Valid values range from 1500 through 9000.

g. Optional: Click **Add IP Interface** to add one or more IP interfaces.

6. Click **OK**.
   If you toggle between the **New** and **Existing** selections, the system applies only the changes from within your last selection.

7. Click **OK** to confirm your changes.

### Detaching an IP interface from an iSCSI target

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > ISCSI Dashboard** to open the iSCSI dashboard.
3. Click **IP Interfaces** to open the IP Interfaces list view.
4. Select an IP interface and click **Detach**.
5. Click **Yes**.

### Disabling an iSCSI target

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > ISCSI Dashboard** to open the iSCSI dashboard.
3. Click **iSCSI Targets** to open the (Attached or Unattached) iSCSI Targets list view.
4. Select an iSCSI target and click **Disable**.
5. Click **Yes**.

### Enabling an iSCSI target

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > ISCSI Dashboard** to open the iSCSI dashboard.
3. Click **iSCSI Targets** to open the (Attached or Unattached) iSCSI Targets list view.
4. Select an iSCSI target and click **Enable**.
5. Click **Yes**.

### Setting port flags

**Before you begin**

The iSCSI target must be in an offline state before the flags can be modified.
Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached).
4. Select an iSCSI target and click Set Port Flags.
5. Select one or more of the following Port Flags:

   **Volume Set Addressing**
   Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

   **Environ Set**
   Enables the environmental error reporting by the storage system to the host on the specific port.

   **Avoid Reset Broadcast**
   Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

   **Disable Q Reset on UA**
   When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

   **Soft Reset**
   Supports SCSI soft reset on a VMAX port when enabled for a Bull/GCOS-7 host.

   **SCSI 3**
   Alters the inquiry data (when returned by any volume on the port) to report that the VMAX system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

   **SCSI Support 1**
   Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

   **SPC2 Protocol Version**
   This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

   **Open VMS**
   Enables an Open VMS fiber connection.

   **ISID Protected**
   Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on iSCSI target, the system uses the ISID and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.
6. Click OK.

**Viewing the iSCSI directors list**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click iSCSI Directors to open the iSCSI Directors list view.

The following properties display, depending on the operating environment:

- **Director**
  - The name of the iSCSI director.

- **Ports**
  - The number of iSCSI physical ports associated with the director.

- **IP Interfaces**
  - The total number of IP interfaces associated with each physical port on the director.

- **Attached iSCSI targets**
  - The total number of unique iSCSI targets attached to the IP interfaces associated with the director.

- **Unattached iSCSI targets**
  - The total number of unique iSCSI targets unattached to the IP interfaces associated with the director.

- **IP Routes**
  - The total number of IP routes associated with the director.

- **Volumes**
  - The total number of volumes mapped to all iSCSI targets on that director.

The following controls are available, depending on the operating environment:

- **Create Target**—Creating an iSCSI target on page 901
- **Add IP Route**—Adding an IP route on page 903
- **View Details**—Viewing the iSCSI director details on page 909

**Viewing the iSCSI director details**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard.
3. Click iSCSI Directors to open the iSCSI Directors list view.
4. Select a row from the list and click View Details to open the iSCSI Directors details view.

The following panels and properties display, depending on the operating environment:

- **Properties panel:**
Director
The name of the iSCSI director.

Number of iSCSI Ports
The number of the iSCSI physical ports associated with the director.

Number of IP Interfaces
The total number of IP interfaces associated with each physical port on the director.

Number of Attached iSCSI Targets
The total number of iSCSI targets attached to the IP interfaces associated with the director.

Number of Unattached iSCSI targets
The total number of iSCSI targets unattached to the IP interfaces associated with the director.

Number of IP Routes
The total number of IP routes associated with the director.

Volumes
The total number of volumes mapped to all iSCSI targets on that port.

Related objects panel:

iSCSI Ports
The list view of iSCSI ports that are associated with this iSCSI director.

IP Interfaces
The list view of IP interfaces that are associated with the physical ports on this director.

Attached iSCSI Targets
The list view of iSCSI targets on this director that are attached to IP interfaces.

Unattached ISCSI Targets
The list view of iSCSI targets on this director that are unattached.

IP Routes
The list view of IP routes associated with this iSCSI director.

Mapped Volumes
The list view of volumes that are mapped to iSCSI targets associated with the director.

Viewing IP interfaces list

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > ISCSI Dashboard to open the iSCSI dashboard.
3. Click IP Interfaces to open the IP Interfaces list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:
Dir:Port
The combination of the physical director and associated port of the IP interface.

Network ID
The network identity of the IP interface that provides isolated IP routes.

IP Address
The destination IPv4 or IPv6 address of the IP interface.

Prefix
The network mask IPv4 or IPv6 prefix value of the IP interface.

VLAN ID
The VLAN tag number of the IP interface.

Dir:Virtual Port
The combination of the physical director and assigned virtual port or iSCSI target alias of the IP interface.

Volumes
The total number of volumes mapped to the iSCSI target attached to the IP interface.

The following controls are available, depending on the operating environment:
- **Create**—Creating an IP interface on page 903
- **Attach**—Attaching an IP interface to an iSCSI target on page 905
- **Detatch**—Detaching an IP interface from an iSCSI target on page 907
- **Delete**—Deleting an IP interface on page 904
- **View Details**—Viewing IP interfaces details on page 911

### Viewing IP interfaces details

#### Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > ISCSI Dashboard**.
3. Click **IP Interface** to open the IP Interface list view and select a specific director to filter the list.
4. Select a row from the list and click **View Details** to open the IP Interfaces details view.

#### Properties panel
The following properties display, depending on the operating environment:

- **Dir:Port**
  The combination of the physical director and the associated port of the IP interface.

- **Network ID**
  The network identity of the IP interface that provides isolated IP routes. This can also be modified.
**IP Address**
The destination IPv4 or IPv6 address of the IP interface. This can also be modified.

**Prefix**
IPv4 or IPv6 prefix length. This can also be modified. You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.

**VLAN ID**
The VLAN tag number of the IP interface.

**Maximum Transmission Unit**
The maximum transit size of the ethernet packet for this IP interface. This can also be modified.

**Dir:Virtual Port**
The combination of the physical director and the assigned virtual port or iSCSI target alias of the IP interface.

**iSCSI target**
The iSCSI target IQN for the attached target.

**Volumes**
The total number of volumes mapped to the iSCSI target attached to the IP interface.

**Volume Set Addressing**
Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

**Environ Set**
Enables the environmental error reporting by the storage system to the host on the specific port.

**Avoid Reset Broadcast**
Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

**Disable Q Reset on UA**
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

**Soft Reset**
Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

**SCSI 3**
Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.
SCSI Support(OS2007)

Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version

Open VMS

This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

ISID Protected

Enables an Open VMS fiber connection.

The following controls are available, depending on the operating environment:

- **Delete**—[Deleting an IP interface](#) on page 904
- **Apply**—Applies updates.
- **Cancel**—Cancels updates.

Related Objects panel

The following related objects display, depending on the operating environment:

- **iSCSI Targets**
  - The list view of iSCSI targets listing the single attached iSCSI target.

- **iSCSI Ports**
  - The list view of iSCSI ports listing the single attached iSCSI port.

- **Mapped Volumes**
  - The list view of volumes that are mapped to iSCSI targets associated with the director.

### Viewing iSCSI targets list

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System** > **iSCSI Dashboard**.
3. Click **iSCSI Targets** (Attached or Unattached) to open the iSCSI Targets list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:

- **Name**
  - The IQN of the iSCSI target.

- **Dir:Virtual Port**
  - The assigned virtual port for the iSCSI target.

- **Status**
  - The status of the iSCSI target.

- **Network ID**
  - The network identity of the IP interface that provides isolated IP routes.
IP Interfaces
The total number of IP interfaces attached to the iSCSI target.

iSCSI Ports
The total number of physical IP ports associated with the iSCSI target.

Volumes
The total number of volumes mapped to the iSCSI target.

The following controls are available, depending on the operating environment:
- **Create**—Creating an iSCSI target on page 901
- **Enable**—Enabling an iSCSI target on page 907
- **Disable**—Disabling an iSCSI target on page 907
- **Set Port Flags**—Setting port flags on page 907
- **Attach**—Attaching an IP interface to an iSCSI target on page 905
- **Detach**—Detaching an IP interface from an iSCSI target on page 907
- **View Details**—Viewing iSCSI target details on page 914
- **Delete**—Deleting an iSCSI target on page 904

**Viewing iSCSI target details**

**Procedure**
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > ISCSI Dashboard** to open the iSCSI dashboard.
3. Click **iSCSI Targets** (Attached or Unattached) to open the iSCSI Targets list view and select a specific director to filter the list.
4. Select a row from the list and click **View Details** to open the iSCSI Targets details view.

**Properties panel**
The following properties display, depending on the operating environment:

**Name**
The IQN of the iSCSI target (editable).

**Dir: Virtual Port**
The assigned virtual port for the iSCSI target.

**Network ID**
The network identity of the IP interface that provides isolated IP routes (editable).

**TCP**
The TCP port to be used for all IP addresses attached to it (editable).

**Status**
The status of the iSCSI target.

**IP Interfaces**
The IP Interfaces attached to the iSCSI target.
Number of IP Interfaces
The total number of IP interfaces attached to the iSCSI target.

iSCSI Ports
The physical iSCSI ports associated with the iSCSI target.

Number of iSCSI Ports
The total number of physical iSCSI ports associated with the iSCSI target.

Volumes
The total number of volumes mapped to the iSCSI target.

The following controls are available, depending on the operating environment:

- **Enable**—Enabling an iSCSI target on page 907
- **Disable**—Disabling an iSCSI target on page 907
- **Set Port Flags**—Setting port flags on page 907
- **Delete**—Deleting an iSCSI target on page 904
- **Apply**—Applies updates.
- **Cancel**—Cancels updates.

Related Objects panel
The following objects display, depending on the operating environment:

**iSCSI Ports**
The list view of iSCSI ports that are associated with this iSCSI target.

**IP Interfaces**
The list view of IP interfaces that are associated with the physical ports on this iSCSI target.

**Volumes**
The list view of volumes that are mapped to this iSCSI target.

**Viewing IP routes list**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI Dashboard**.
3. Click **IP Routes** to open the IP Routes list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:

**Destination IP**
The IPv4 or IPv6 destination IP address of the IP route.

**Prefix**
The IPv4 or IPv6 network mask prefix of the IP route.

**Gateway IP**
The gateway IP address of the IP route.
Network ID
The network identity of the IP route.

Director
The director with which the IP route is associated.

The following controls are available, depending on the operating environment:
- Add IP Route—Adding an IP route on page 903
- Remove—Removing an IP route on page 904
- View Details—Viewing the IP routes details on page 916

Viewing the IP routes details

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard > to open the iSCSI dashboard.
3. Click IP Routes to open the IP Routes list view and select a specific director to filter the list.
4. Select a row from the list and click View Details to open the IP Routes details view.

Properties panel
The following properties display, depending on the operating environment:
- Destination IP
  The IPv4 or IPv6 destination IP address of the IP route.
- Prefix
  The IPv4 or IPv6 network mask prefix of the IP route.
- Gateway IP
  The gateway IPv4 or IPv6 address of the IP route.
- Network ID
  The network identity of the IP route.
- Director
  The director with which the IP route is associated.

The following control is available, depending on the operating environment:
- Remove—Removing an IP route on page 904

Related Objects panel
The following objects display, depending on the operating environment:
- iSCSI Director
  The list view containing the associated director for the selected IP route.
Viewing iSCSI ports list

Procedure

1. Select a storage system running or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click iSCSI Ports to open the iSCSI Ports list view and select a specific director to filter the list.

   The following properties display, depending on the operating environment:
   
   **Director**
   - The name of the iSCSI director.
   
   **Port**
   - The iSCSI physical port number associated with the director.
   
   **Status**
   - The current status of the physical port (offline or online).
   
   **IP Interfaces**
   - The total number of IP interfaces associated with the physical port.
   
   **iSCSI targets**
   - The number of iSCSI targets that are attached to the IP interfaces.
   
   **Volumes**
   - The total number of volumes mapped to all iSCSI targets on that port.

The following controls are available, depending on the operating environment:

- Create IP Interface—Creating an IP interface on page 903
- View Details—Viewing iSCSI ports details on page 917

Viewing iSCSI ports details

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI Dashboard to open the iSCSI dashboard.
3. Click iSCSI Ports to open the iSCSI Ports list view and select a specific director to filter the list.
4. Select a row from the list and click View Details to open the iSCSI Ports details view.

   Properties panel
   
   The following properties display, depending on the operating environment:
   
   **Dir: Port**
   - The name of the director and the iSCSI port combined.
   
   **Status**
   - The current status of the iSCSI port (offline or online).
**Number of IP Interfaces**
The total number of IP interfaces attached to this iSCSI port.

**Number of iSCSI Targets**
The total number of iSCSI targets to all the IP interfaces on the selected iSCSI port.

**Number of Volumes**
The total number of volumes mapped to all iSCSI targets on this port.

**Speed GB/Sec**
The speed of the iSCSI port.

**Related Objects panel**
The following objects display, depending on the operating environment:

- **IP Interfaces**
  The list view of IP interfaces that are associated with the physical ports on this director.

- **Attached iSCSI Targets**
  The list view of iSCSI targets on this director that are attached to IP interfaces.

- **Unattached iSCSI Targets**
  The list view of iSCSI targets on this director that are unattached.

- **Mapped Volumes**
  The list view of volumes that are mapped to iSCSI targets associated with the director.

- **iSCSI Director**
  The list view listing the director that is associated with the selected iSCSI port.

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**Viewing storage system capacity reports**

This procedure explains how to view capacity reports for all storage systems visible to the console:

**Procedure**

1. From the system selector, select **All Symmetrix**.
2. Select **> VMAX Capacity** to open the **Symmetrix Capacity** list view.

**Results**

The following properties display:

- **Symmetrix ID**—Storage system serial ID.
- **Total Physical Capacity (GB)**—Total capacity of all the disk on the storage system.
- **Used Physical Capacity (GB)**—Used capacity of all the disks on the storage system.
- **Total Virtual Capacity (GB)**—Total capacity of the thin pools on the storage system.
Allocated Virtual Capacity (GB)—Sum of the total used capacity of all the thin pools on the storage system and the total free capacity of all the thin pools on the storage system.

# Storage Groups—Number of storage groups on the storage system.

The following controls are available:

Export Report—Exporting capacity reports on page 84
View Storage Group Capacity Report—Viewing storage group capacity reports on page 84

Viewing storage group capacity reports

Viewing storage group capacity reports.

This procedure explains how to view capacity reports for all storage groups on a storage system:

**Procedure**

1. From the system selector, select All Symmetrix.
2. Select Home > VMAX Capacity to open the Symmetrix Capacity list view.

Results

The following properties display:

Name — Storage group name.

Total Capacity (GB) — Total capacity of all the volumes in the storage group.

Allocated Capacity (GB) — Allocated capacity of all the thin volumes in the storage group.

The following control is available:

Export Report—Exporting capacity reports on page 84

Exporting capacity reports

Exporting capacity reports.

This procedure explains how to export capacity reports:

**Procedure**

1. From the system selector, select All Symmetrix.
2. Select Home > VMAX Capacity to open the Symmetrix Capacity list view.
3. Do the following, depending on whether you are exporting a storage system capacity report or a storage group capacity report:
   - Storage system:
     Click Export Report.
   - Storage group:
     Select a storage system and click View Storage Group Capacity Report.
     Click Export Report.
     Click OK.
     Select a location to download the report.
     Click Save.